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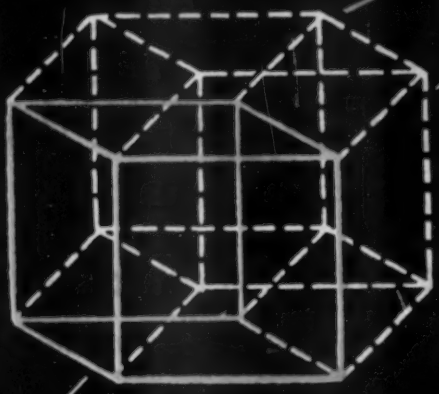

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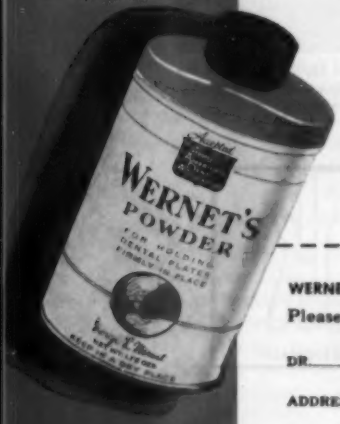

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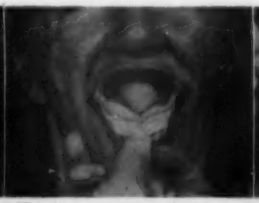

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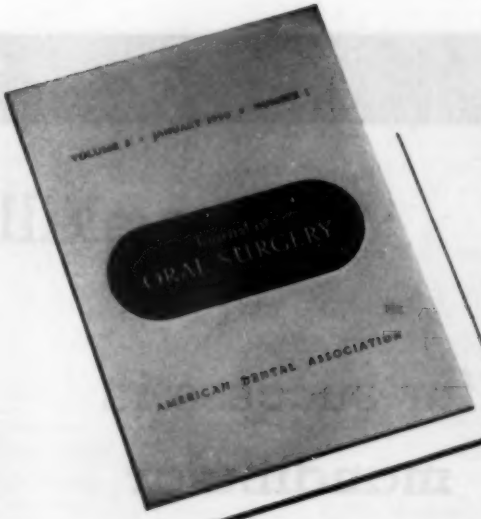

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(1) Kazis "The Anesthetic of Choice for complete Mouth Rehabilitation", D. I. of Int., 7/32.

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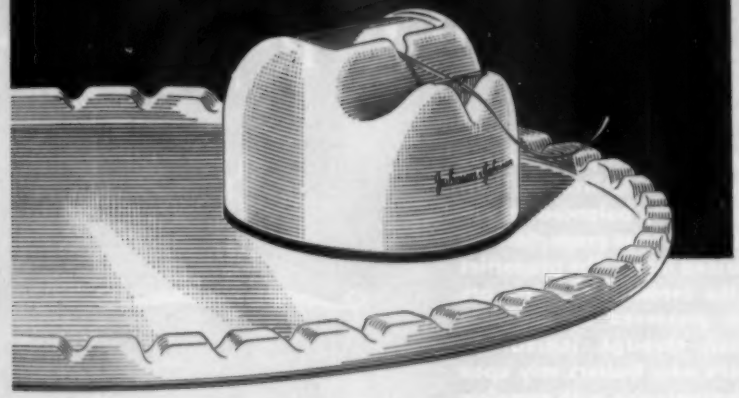

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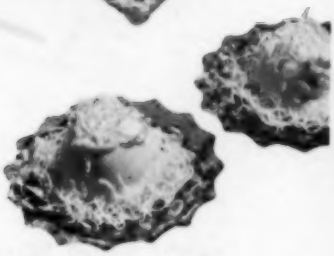

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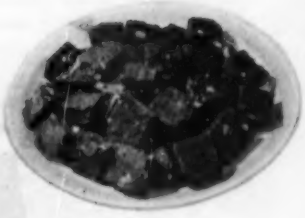

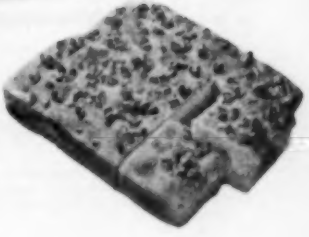

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NOVEMBER 1954 VOLUME 49 • NUMBER 5

THE Journal OF THE AMERICAN DENTAL ASSOCIATION

Mechanical properties of direct filling resins

W. T. Sweeney, A.B.; W. D. Sheehan,† B.S., and E. L. Yost,† B.S., Washington, D. C.*

The success of any material used to restore lost tooth structure depends to a large extent on its physical and chemical properties. This applies to all types of filling materials, whether they are metallic, ceramic or resinous. The development of direct filling resins and their widespread use as restorative materials where esthetics must be considered make it desirable to know more about their mechanical properties. A knowledge of these properties will aid in determining the type of restorations for which these resins are most suitable and in determining the technics that should be used to obtain optimum results with these materials.

The mechanical properties investigated are those of special interest in the evaluation of resinous filling materials. The compressive modulus of elasticity of the resin is an index to its stiffness and to the resistance of the restoration to forces tending to cause movement at the margin or pressure on the walls of the cavity. The compressive yield strength is a measure of the forces required to cause a permanent deformation in the restoration. The resistance of the resin to indentation under a continuous load is considered to be an indication of its ability to resist deformation in the mouth in locations where forces are applied on occlusal surfaces or at contact points.

The investigation of the properties of direct filling resins was somewhat complicated by the fact that these resins polymerize in the tooth and that the temperature rise on polymerization,[1] the rate of hardening, and the completeness of polymerization depend on the size of the restoration. For these reasons, measurements of mechanical properties were made on specimens comparable in size to

*Chief, Dental Research Section, National Bureau of Standards.

†Guest worker, U. S. Army, stationed at National Bureau of Standards.

1. Wolcott, R. B.; Paffenberger, G. C., and Schoonover, I. C. Direct resinous filling materials: temperature rise during polymerization. J.A.D.A. 42:253 March 1951.

Table 1 • Direct filling resins investigated

Trade brand	Manufacturer
Ames	The W. V-B Ames Co.
A-thermoplast V-10	Athermoplast Products, Inc.
Dentafil	Dental Fillings, Ltd.
Duz-all	Coralite Dental Products. Co.
Fastcrown	Acralite Co., Inc.
Kadon	The L. D. Caulk Co., Inc.
Plasto-filling pf3	Plastodent, Inc.
Replica	Cosmos Dental Products, Inc.
Texton	S. S. White Dental Mfg. Co.
Vitafilling	Vitaliner Co.

restorations used in practice. Since change in mechanical properties continues for some hours, a series of determinations was made on specimens of different ages. Determinations of the modulus of elasticity, yield strength and resistance to indentation of ten brands of direct resin filling materials (Table 1) are reported in this paper. All the samples were obtained prior to 1953.

EXPERIMENTAL PROCEDURE AND RESULTS

Compressive Modulus of Elasticity and Yield Strength • To determine the compressive modulus of elasticity and yield strength of the resins, loads were applied to cylindrical specimens 3 mm. in diameter and 6 mm. in length with a 2,000 lb. capacity pendulum, screw-driven universal testing machine, and the strain was measured with Tuckerman strain gauges.

All specimens were prepared and tested in a constant temperature room at 23 ± 1°C. (73.4 ± 2°F.) to insure uniformity of specimens and of testing procedure. Mixing was done according to the manufacturers' directions insofar as details were available. Approximately 0.75 Gm. of polymer with the recommended ratio of liquid was employed for each mix. Specimens were molded in a stainless steel split-mold (Fig. 1) consisting of six cavities, each accurately machined to 3 mm. in diameter and 6 mm. in length. The mold was assembled and slightly overfilled with the resin when it had reached the condition in which it would normally be placed in the tooth cavity. A steel plate was placed on top of the mold, and pressure was applied by two screw-clamps. Immediately after it was clamped, the mold was placed in an oven regulated to 37 ± 1°C. (98.6 ± 2°F.). After 30 minutes the mold was removed from the oven and disassembled. The specimens were removed and allowed to stand at 23°C. (73.4°F.) for 3 to 5 days before testing.

The procedure used for measuring the compressive modulus of elasticity was as follows. Because of the shortness of the specimens, the 1 inch Tuckerman strain gauges were attached to steel pins between which the specimens were held in the testing machine (Fig. 2). The error due to this pin arrangement was found to be negligible because of the size of the pins (½ inch diameter) and the relatively low modulus of the plastic.

A continuous load was applied with the testing machine, using a head speed of 0.20 inches per minute. This corresponds to an average strain rate of approximately 0.003 inches per inch per minute. The strain was read from the Tuckerman strain gauges by means of an

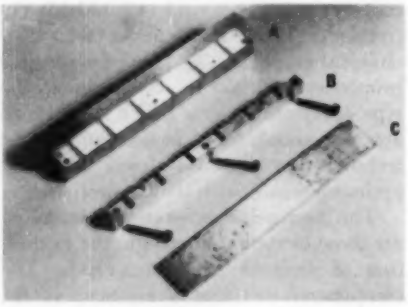

Fig. 1 • Apparatus used to mold specimens for stress-strain measurements. Part B fits into Part A and is fastened by screws. Cavities are then packed, the top steel plate is placed over cavities and pressure is applied by screw-clamps

autocollimator[2] at 2.5 pound load increments. Loads were recorded from 5 to approximately 100 pounds, depending on the yield strength of the material. Six specimens of each brand were used to obtain an average value. Figure 3 shows the variation in the stress-strain relationship obtained on six specimens of a typical material. The coefficient of variation for the modulus of elasticity for these curves is 9.9 per cent. The variations were caused mainly by differences in individual specimens.

The average compressive moduli of elasticity of the direct filling materials investigated varied from 1.62 to 3.14 x 10^5 psi (Table 2). The average stress-strain curves of the materials are shown in Figures 4 and 5. The compressive modulus of elasticity was computed over the stress range of 1,000 to 5,000 psi.

The compressive "yield strength" for the purpose of this paper is defined as the stress (load per unit of cross-sectional area) at which the deformation produced by a stress increment equals or exceeds 1.25 times that observed in the first few increments of stress starting at approximately 1,000 psi.[3] The calculated compressive yield strengths (Table 2), which represent an approximation of the stress that can be applied to the resin without permanent deformation, ranged from 4,600 to 7,400 psi.

Resistance to Indentation • The resistance of the resins to indentation was observed by applying loads to specimens with the Rockwell Superficial Hardness Tester. By observing the change in the depth of indentation while the load remained on the resin for ten minutes, flow properties were determined. Recovery after flow was determined by measurements made after removal of the load. The relationship between degree of polymerization and resistance to indentation was determined by loading specimens at various lengths of time after preparation.

The specimens were prepared in accordance with the standard mixing procedure and formed at a temperature of 23 ± 1°C. (73.4 ± 2°F.) in tinfoil-lined brass molds 34 mm. long by 12 mm. wide by 1.5 mm. deep. A load of 2 Kg. was placed on the top plate of the mold immediately after the insertion of the resin. Specimens to be tested ten minutes after the start of the mix were removed from the mold at eight and one-half minutes and stored at room temperature until placed in the testing equipment. All other specimens were removed from the mold 25 minutes after the start of the mix and stored at 37 ± 1°C. (98.6 ± 2°F.) until five minutes before testing, at which time they were allowed to come to room temperature.

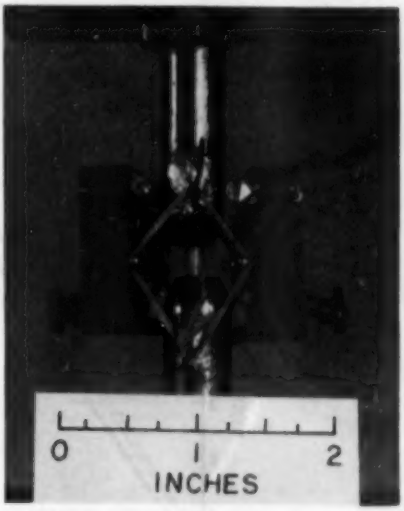

Fig. 2 • Specimen and gauges in position between platens of testing machine used to record compressive stress-strain relationships

In measuring the resistance to inden-

2. Tuckerman, L. B. Optical strain gages and extensometers. Proc. Am. Soc. Test. Mat. 23:602 (Part II) June 1923.

3. Paffenbarger, G. C.; Sweeney, W. T., and Isaacs, A. Wrought gold wire alloys. J.A.D.A. 19:2061 Dec. 1932.

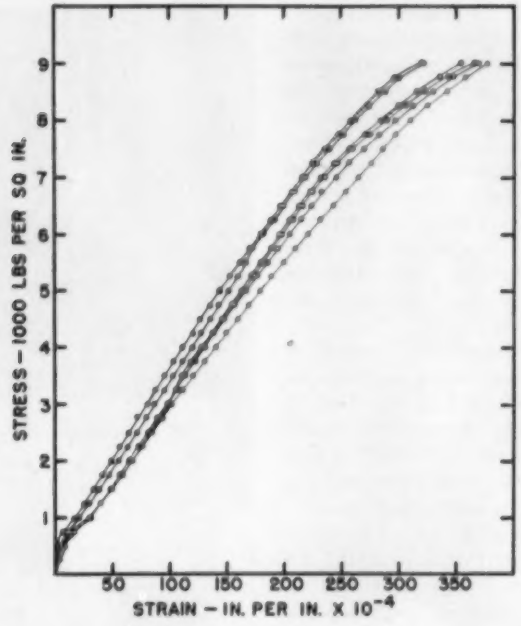

Fig. 3 • Compressive stress-strain data showing variations obtained on six specimens of a particular brand of direct filling resin

Table 2 • Compressive moduli of elasticity and yield strengths of direct filling resins

(Specimens aged 3-5 days)

Material	Modulus of elasticity (Average)*	Standard deviation	Coefficient of variation	Yield strength (Average)*	Standard deviation	Coefficient of variation
	PSI	PSI	%	PSI	PSI	%
Ames	2.66×10^5	0.07×10^5	2.6	5,400	320	5.9
A-thermoplast V-10	1.62	.40	24.7	4,600	310	6.7
Dentafil	2.66	.36	13.5	6,600	580	8.8
Duz-all	2.73	.19	7.0	6,400	540	8.4
Fastcrown	2.64	.10	3.8	6,200	440	7.1
Kadon	3.14	.36	11.5	7,400	650	8.8
Plasto-filling pf3	2.98	.16	5.4	7,300	400	5.5
Replica	3.04	.35	11.5	7,000	300	4.3
Texton	2.74	.18	6.6	——	—	—
Vitafilling	2.71	.34	12.5	6,400	930	14.5
Average	2.69	.25	9.9	6,400	500	7.8

*Average for six specimens.

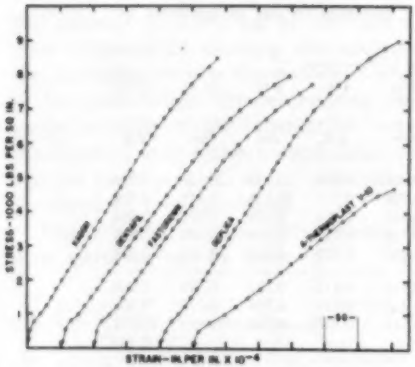

Fig. 4 • Compressive stress-strain curves for five different brands of direct filling resins

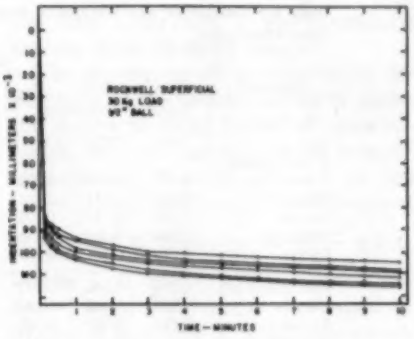

Fig. 6 • Variability of indentation measurements of six specimens of one brand of direct filling resin when tested by Rockwell superficial hardness tester

tation in the Rockwell Superficial Hardness Tester, the Y-30 scale that employs a minor load of 3 Kg., a major load of 30 Kg., and a ½ inch steel ball was used. The minor load was used for the fiducial reading and the major load applied for ten minutes was used to indent the material. Observations were taken at frequent intervals in order to determine the relationship between depth of indentation and time of load application. Indentation depth was read to ± 0.001 mm. by means of the dial indicator.

The uniformity of the data obtained in measuring indentation is shown in Figure 6. The coefficient of variation obtained when testing five specimens of an individual brand was found to be 6 per cent. The calculated standard deviation is of the magnitude of 0.006 mm. As in the stress-strain determination, it is felt that the deviations in individual de-

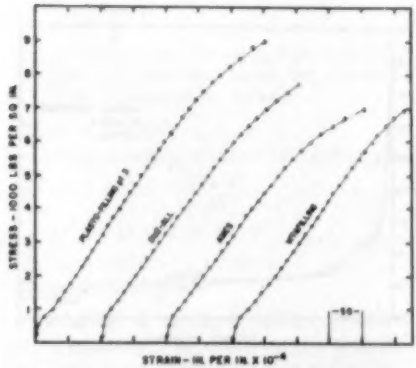

Fig. 5 • Compressive stress-strain curves for four different brands of direct filling resins

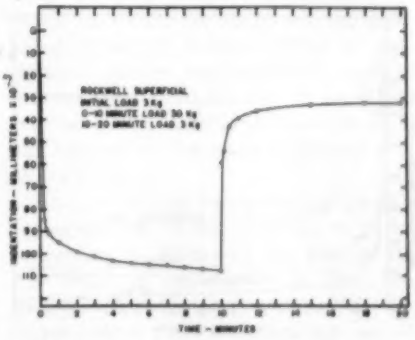
ROCKWELL SUPERFICIAL
INITIAL LOAD 3 Kg
0-10 MINUTE LOAD 30 Kg
10-20 MINUTE LOAD 3 Kg
INDENTATION - MILLIMETERS X 10⁻²
TIME - MINUTES

Fig. 7 • Indentation plotted against time for typical indentation and recovery curve

Table 3 • Indentation and indentation strength according to age of specimens of direct filling resins

Material	Age of specimens							
	10 min.	30 min.	1 hr.	2 hr.	4 hr.	6 hr.	24 hr.	120 hr.
	Depth of indentation*							
	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
A-thermoplast V-10	0.277	0.210	0.202	0.181	0.150	0.146	0.137	0.115
Dentafil	0.227	0.173	0.136	0.126	0.117	0.114	0.111	0.109
Duz-all	0.217	0.139	0.122	0.111	0.104	0.101	0.095	0.096
Fastcrown	0.264	0.165	0.146	0.136	0.112	0.115	0.104	0.101
Kadon	0.219	0.165	0.142	0.135	0.122	0.115	0.102	0.105
Plastofilling pf3	0.235	0.146	0.122	0.116	0.112	0.110	0.110	0.102
Replica	0.228	0.153	0.142	0.131	0.121	0.116	0.110	0.106
Texton	0.224	0.167	0.160	0.144	0.127	0.118	—	0.104
Vitafilling	—	—	—	—	—	—	—	0.103
Average	0.236	0.165	0.146	0.135	0.121	0.117	0.109	0.104
	Indentation strength							
	psi	psi	psi	psi	psi	psi	psi	psi
Average	4,100	5,900	6,700	7,200	8,000	8,300	8,900	9,300

*Average for five specimens. Major load applied for 10 minutes.

terminations are caused chiefly by unavoidable differences in individual specimens rather than by inherent errors in the apparatus and technics.

Data for a typical indentation and recovery curve are shown in Figure 7.

Table 3 and Figures 8 and 9 give the indentation values for a ten minute application of the major load for specimens of various ages up to 120 hours. As shown in Table 3, the average depth of indentation at ten minutes was more than twice the depth of indentation at 120 hours, and the average depth at 30 minutes was more than one and one-half times that at 120 hours. Also included in Table 3 are values for "indentation strength." These figures, ranging from 4,100 psi at

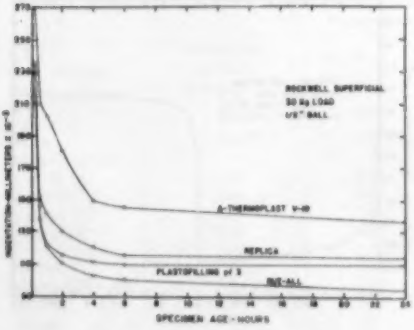

Fig. 8 • Increase in hardness with age shown by plotting indentation against age of four different specimens

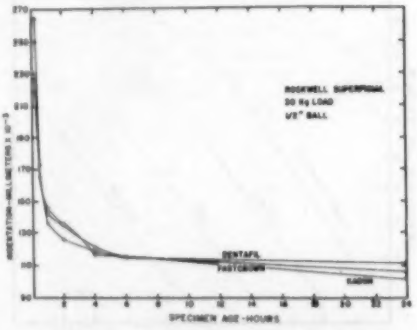

Fig. 9 • Increase in hardness with age shown by plotting indentation against age of three different specimens

ten minutes to 9,300 psi at 120 hours, were obtained by dividing the load on the indenting tool by the projected area of the indentation. In determining the projected area of the indentation from the depth of indentation a correction was applied to include the slight indentation produced by the minor load.

The corrected equations for projected area were derived as follows:

(1) $\frac{L}{A} = \frac{L'}{A'}$ = Indentation strength

(2) $A' = \pi(2Ry' - y'^2)$

(3) $A = \pi[2R(y + y') - (y + y')^2]$
where

L = major load on indenter

$L' = \frac{L}{10}$ = minor load on indenter

A = projected area of indentation produced with major load

$A' = \frac{A}{10}$ = projected area of indentation produced with minor load

R = radius of indenter sphere

y' = depth of indentation produced with minor load

y = instrument reading with major load applied

$y + y'$ = depth of indentation produced with major load

(4) If in the above equation the y'^2 and $(y + y')^2$ terms which are relatively small are neglected it can be seen that

$$A' = \frac{2\pi R\, y}{9}$$

or substituting the value 0.25 inch for R and including the factor for converting y in millimeters to inches.

(5) $A' = 0.00687y$

A more nearly accurate calculation gives

(6) $A' = \frac{2\pi R\, y}{9} - \frac{11\pi\, y^2}{81}$

or substituting as above

(7) $A' = 0.0687y - 0.00066y^2$

Indentation strength values obtained using equation 7 to compute the area differ from those obtained using equation 5 by less than 2.5 per cent if the indentation reading is less than 0.25 mm. and by less than 1 per cent if the indentation reading is less than 0.1 mm.

The percentage of recovery after indentation of the various brands of material increased from values of approximately 40 ± 10 per cent at 30 minutes to values of 70 ± 10 per cent at 120 hours (Table 4). Recovery was computed as follows: $\%\ \text{Recovery} = \frac{I - I'}{I} \times 100$. Where I is the depth of indentation caused by a ten minute application of the major load, and I′ is the indentation remaining ten minutes after removal of the major load but with the minor load still applied.

DISCUSSION OF RESULTS

One important characteristic of the direct filling resins demonstrated by the data is their change in properties during the first few hours after mixing of the monomer and polymer. This change is evident in the results that show the relationship between depth of indentation and age of specimen (Fig. 8 and 9 and Table 3). The resistance to indentation increases rapidly for approximately six hours. After this there is slight increase in resistance during the period from 6 to 24 hours, after which this property remains essentially constant. Table 4 shows that the extent to which the resins recover after being deformed is also related to age. Recovery under the conditions used in this test was approximately 30 to 50 per cent when the specimens were ½ hour old, but was of the order of 75 per cent after 24 hours.

That the change in mechanical properties is related to completeness of polymerization is illustrated by Figure 10. The depth of indentation, or flow, obtained at ten minute application of the major load is plotted against the age of the specimen. Monomer content of the same specimens, determined by a modified form of the method employed by

Table 4 • Recovery of direct filling resins

Material	Age of specimen							
	10 min.	30 min.	1 hr.	2 hr.	4 hr.	6 hr.	24 hr.	120 hr.
	Recovery							
	%	%	%	%	%	%	%	%
A-thermoplast V-10	*	30	36	45	50	55	55	60
Dentafil	4	38	46	58	56	64	68	69
Duz-all	21	53	61	61	74	75	81	80
Fastcrown	1	42	49	53	55	64	69	71
Kadon	29	41	49	64	63	64	73	79
Plastofilling pf3	14	45	60	68	73	68	77	76
Replica	17	42	49	53	55	64	69	71
Texton	27	42	43	50	58	64	—	80
Vitafilling	—	—	—	—	—	—	—	75

*Too soft to measure.

Note: Recovery computed as per cent of indentation depth recovered ten minutes after major load (30 Kg.) was released and minor load (3 Kg.) remained.

Lewis and Mayo,[4] is also plotted against the age of the specimen. These data demonstrate the importance of the presence in the direct filling resins of the proper catalysts and accelerators to cause the polymerization of the resins to be as complete as possible.

There is some indication that those resins that cure most rapidly, as evidenced by early peak temperatures,[1] have higher moduli of elasticity and yield strengths.

The data on compressive modulus of elasticity point out one of the greatest weaknesses of the resins. The values obtained were approximately 60 per cent of the value obtained for a well-cured denture base resin. Gold alloys used for inlays have a modulus of 15 million psi, while that of the resins is of the order of 0.3 million psi. This means that equal forces on similar specimens of resin and gold will produce approximately 50 times as much deformation in the resins as in the gold. Clinically this indicates that these resins should be used in restorations where they will be well supported by tooth structure. Forces applied to unsupported resin restorations will result in deformation with resultant movement at the margins of the restoration.

The relatively low compressive yield strength and low resistance to indentation of the direct filling resins limit their usefulness to some extent. The resistance to indentation is approximately one half that of amalgam. The average yield strength was found to be 6,400 psi. Since biting forces of over 100 pounds are not uncommon,[5] it can be seen that stresses

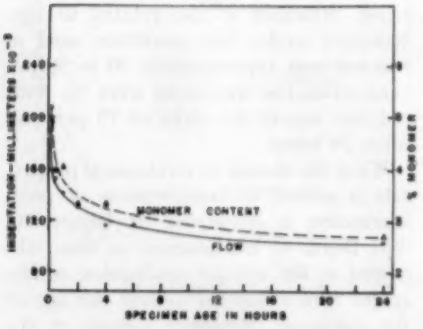

Fig. 10 • Relationship between monomer content and flow

4. Lewis, F. M., and Mayo, F. R. Precise method for isolation of high polymers, analytical edition. Ind. & Eng. Chem. 17:134 March 1945.

5. Howell, A. H., and Manly, R. S. Electronic strain gauge for measuring oral force. J. D. Res. 27:705 Dec. 1948.

of over 6,400 psi could occur on occlusal surfaces and that plastic flow would occur on direct filling resins in such locations.

The data presented in the report evaluate the mechanical properties of the ten brands of direct filling resins investigated. The superiority of one brand over another, however, cannot be judged by mechanical properties alone. To make an over-all evaluation, it would be necessary to consider in addition such factors as porosity, curing shrinkage, dimensional stability, color stability and clinical behavior.

CONCLUSIONS

1. Methods were developed for measuring mechanical properties of small specimens of resin comparable in size to tooth restorations by use of two standard testing machines.

2. The direct filling resins tested were found to improve in mechanical properties during a period of approximately 24 hours after mixing. This improvement coincided with a decrease in monomer content during the same period.

3. The compressive moduli of elasticity of the resins tested ranged from 1.62 to 3.14 x 10^5 psi, indicating that, as compared with other restorative materials, the resins are low in stiffness.

4. The yield strength in compression of the direct filling resins varied from 4,600 to 7,400 psi. This low value would permit plastic flow to occur under stresses that might be encountered on occlusal surfaces.

5. The values obtained on the resins for resistance to indentation were approximately one half of the values obtained on dental amalgam.

6. In general, the mechanical properties of the direct filling resins are low in comparison with the properties of dental golds, amalgam, and denture base materials.

Science and Human Progress • It is only with the aid of science that we hope to complete our task and it is to science that we turn with anxiety and hope for a solution of our stupendous problems. I am particularly convinced of the necessity of making the great masses aware of the methods and achievements of scientific research, and to make them understand, in a form which they can assimilate, the impact of science on our daily behavior. One can scarcely envisage raising the standard of living of the world's population without a very broad understanding of scientific progress, an understanding which will strengthen the action of the Government at all stages through the comprehensive participation of a well-informed public opinion. This can be achieved only by developing to the largest possible extent the dissemination of scientific information amongst all peoples. *B. Patnaik, quoted in "The Conquest of Kalinga by Asoka Brought Peace and Buddhism to India—Modern Orissa, through Unesco, Revives an Historic Name," by Gerald Wendt, Natural Sciences Department, Unesco, Science in Plain Language, p. 12.*

Spontaneous intermittent resorption of teeth

Henry M. Goldman, D.M.D., Boston

Spontaneous intermittent resorption of tooth tissue is of considerable interest and importance, since an understanding of the process offers further insight into the reactions of dental structure to environment and increased knowledge concerning metabolism of the tooth.

In the first report of this condition, made in 1901 by Miller,[1] the term "pink spot" was used to describe the condition. In numerous reports published since then, various terms have been used, including "idiopathic resorption of tooth" and "internal resorption of tooth." In this article the term "spontaneous intermittent resorption" is used, since it seems the most appropriate description of the nature of the lesion.

MATERIAL AND METHODS

Seventy-six teeth in 73 cases of spontaneous intermittent resorption of tooth tissues were studied; 64 histologic specimens were examined. Clinical data were recorded concerning the frequency of location of the lesion—crown, cervix or root—age of patient, symptoms, site of origin, relationship to caries, status of eruption, and presence of a root canal filling.

For the histological examination, the teeth were fixed in Formalin and embedded in celloidin; a few were cut serially. The histological data included the location of the lesion as viewed microscopically, the activity of the resorptive process, the type of the replacement tissue and its final condition, and the condition of the pulp. The possibility of a relationship between the resorptive process and the presence of caries also was noted.

The roentgenographical data included the characteristics of the resorptive lesion and its possible relationship with any existing carious lesion, filling or root canal filling. Comparison of the roentgenogram and the histologic appearance afforded further information concerning the location and possible site of origin.

CLINICAL OBSERVATIONS

Seventy-three of the 76 teeth studied were permanent, and 3 were deciduous teeth. The sex of 8 patients was unknown; of the remaining patients, 36 were males and 29 females. Most of the patients were over 40 years of age (table). Although in 38 cases the examination was routine, there was pain in 23 cases. In 2 cases the tooth was fractured; in 1 case there was a retained root. Absorptive lesions occurred in the crown in 23 cases, in the cervical region in 25 cases, in the root in 24 cases, in the cervical root in 3 cases and throughout the tooth in 1 case. In 36 cases there was no caries; in 36 cases caries was detected. Root canal fillings were ob-

Director, Riesman Dental Clinic, Beth Israel Hospital.

1. Miller, W. D. A study of some dental anomalies with reference to eburnitis. D. Cosmos 43:845 Aug. 1901.

served in 7 teeth. No causal relationship between the lesions and caries or root canal filling was established. Sixty of the teeth were erupted; absorptive lesions were observed in 14 unerupted teeth.

ROENTGENOGRAPHIC FINDINGS

Roentgenographic study revealed that spontaneous intermittent resorption may assume a variety of appearances, depending not only on the site of the lesion but also on the reparative process. Central or peripheral radiolucent irregularly shaped areas could be distinguished. The lesions were observed in the crown, in the cervical portion or in the root. The roentgenograms of Figure 1 are typical. Figure 1, j, shows the gross specimen of an internal lesion; Figure 1, k, shows a peripheral lesion. The channeling in the latter is irregular and pitted, whereas in the former the periphery of the resorptive lesion is smooth and is connected with the pulpal wall.

HISTOLOGICAL FINDINGS

Figure 2 shows the variability of the pattern of the spontaneous intermittent resorption process. Figure 2, a, is a low-power photomicrograph of the internal lesion which is shown in Figure 1, c. Serial sections were studied to determine whether there was any connection of the lesion with the periphery, but none could be established.

The resorptive process varied in activity from a resting stage to one of active resorption (Fig. 3, above right) associated with multinucleated giant cells. The tooth surface often appeared scalloped as in the usual process of bone resorption (Fig. 3, above left). Occasionally the surface was irregularly pitted as in the bone trabeculae in osteomyelitis, especially when there was an inflammatory exudate adjacent to the hard structure (Fig. 3, left center). The histologic sections in Figure 3, right above, and left below, illustrate the stage of very active resorption. In the cases studied, the resorptive process was inactive in 14 cases, active in 35 cases and very active in 15 cases. The appositional process was inactive in 21 cases, active in 19 cases and very active in 18 cases. The resorptive process of replacement tissue was inactive in 40 cases, active in 10 cases and very active in 6 cases.

Table • Age distribution of study group

	Male	Female	Total
Under 20	5	2	7
20—29	2	5	7
30—39	2	2	4
40—49	8	6	14
50—59	4	6	10
60 and over	7	2	9
Unknown age	8	6	14
Unknown sex and age			8
TOTAL	36	29	73

The origin of the multinucleated giant cells is unknown. The explanation that when they are adjacent to bone they are an accumulation of liberated bone cells appears possible, but it does not explain their origin when the dentin undergoes resorption.

The fibrous connective tissue adjacent to the resorptive process varied in composition from a loose edematous tissue to a collagenous one. The cells were variable in form; some were long and spindle-shaped, some round and some stellate. In some cases the tissue was interspersed with inflammatory cells, consisting entirely of plasma cells and lymphocytes, whereas in other instances there was a heavy infiltrate. Inflammatory cells were usually present at the site of the resorptive process despite the fact that the remaining portion of the pulp sometimes showed no evidence of an inflammatory infiltrate.

In the cases studied the replacement tissue (Fig. 4) consisted of osteocementum in 31 cases, compact bone in 11 cases, cancellated bone in 10 cases, ce-

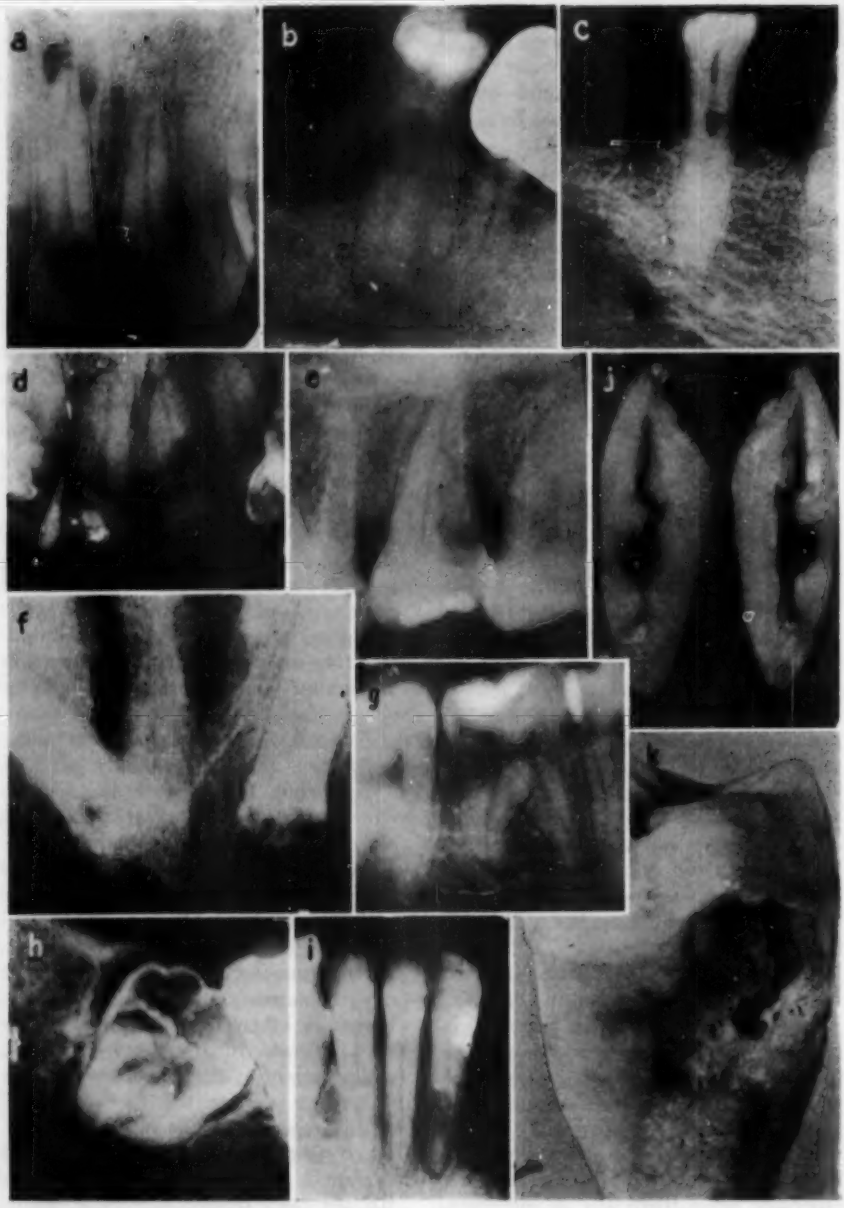

Fig. 1 • a-k: Roentgenograms and photographs of cases of spontaneous intermittent resorption of teeth. j, internal lesion; k, peripheral lesion

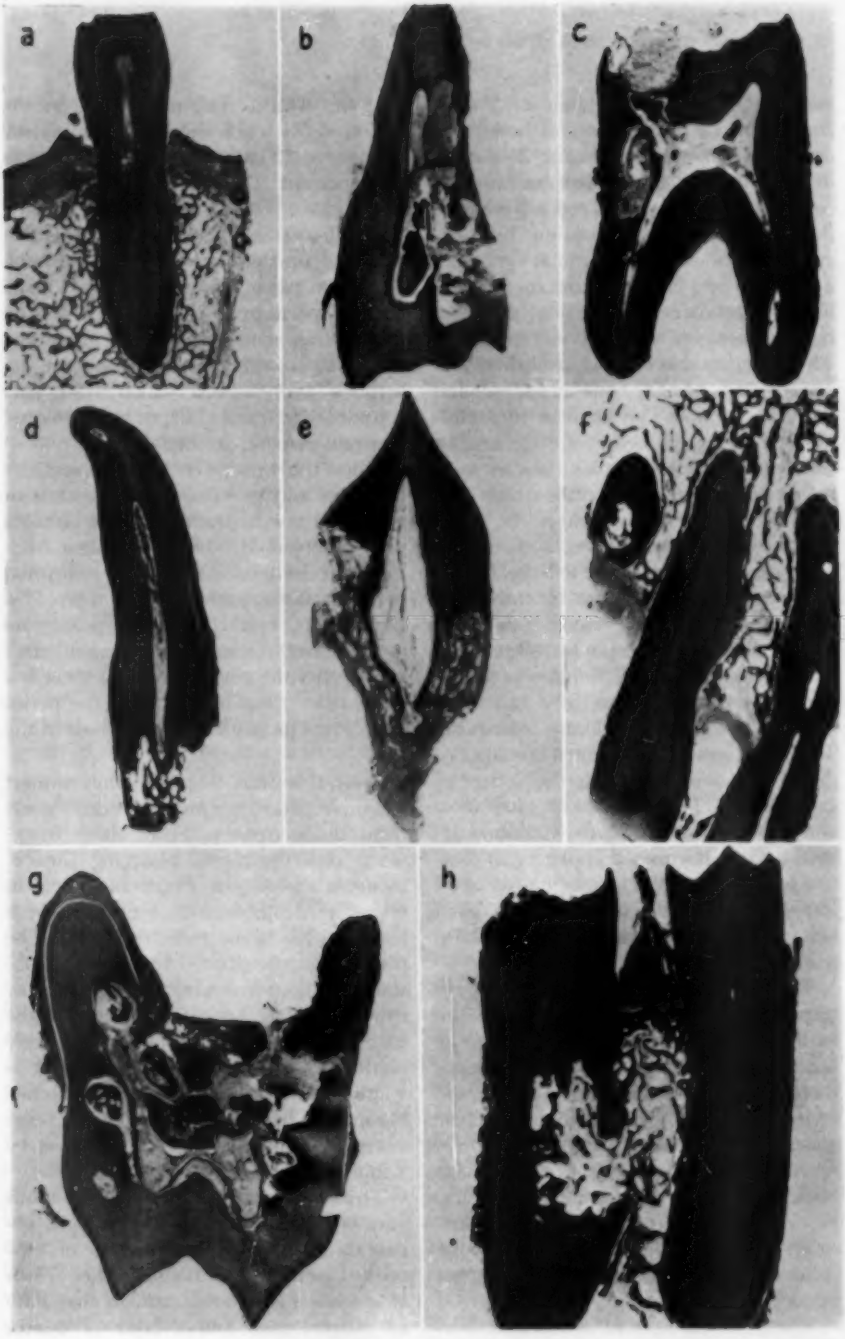

Fig. 2 • a-h: Low-power photomicrographs of eight cases of spontaneous intermittent resorption. Corresponding roentgenograms and photomicrographs are: Figure 1, c and 2, a; 1, e and 2, b; 1, g and 2, c; 1, f and 2, d

mentum and compact bone in 1 case, compact bone and cancellous bone in 4 cases and cementum and cancellous bone in 1 case. As a rule, osteocementum or compact bone was observed adjacent to the lesion. Where resorption had occurred previously, the dentin at times had a covering of a calcified substance resembling cellular cementum or primitive bone, sometimes termed osteocementum. This covering was somewhat fibrillar and coarser than normal bone and somewhat more basophilic. The lacunae surrounding the "bone" cell were somewhat smaller and more irregular than those of bone. For the most part the tissue was solid with no marrow spaces. In other instances, however, this replacement tissue appeared more similar to bone. Often, the tissue was laid down in trabecular layers with abundant cement substance.

The replacement tissue often consisted of cancellated bone. The marrow spaces varied in size and quantity but were similar to those of ordinary spongiosa. The bone was arranged in trabeculae of different sizes and shapes in the pattern of normal bone. The marrow was often fatty and in some instances somewhat fibrosed; at times it appeared completely fibrous, comparable with the connective tissue of fibrous dysplasia. This type of cancellated bone was usually observed where there was no inflammatory infiltrate.

The replacement tissue undergoes resorptive changes similar to those of the tooth structure; both processes occur concomitantly. Evidence of these changes was (1) the appositional tissue laid down, which consisted of an osteoblastic layer and rims of osteoid, (2) baylike depressions on the surface of the replacement tissue and (3) multinucleated giant cells. Figure 3, below left, and Figure 4, below right, show the replacement tissue-bone being actively resorbed by the numerous osteoclasts.

The pulp was normal in 16 cases. The internal resorptive lesion seemingly originated on the pulpal wall and extended into the dentin. The pulp tissue in the region of the lesion showed inflammatory changes in 22 cases; numerous capillaries were present. The pulp was degenerated in 15 cases. The blood vessels extended with the soft tissue into the defect, which slowly channeled its way into the dentin. In some cases the replacement tissue covered portions of the denuded dentin. Often fragments of it were observed which had been isolated during the resorptive process and which were surrounded by newly deposited osteocementum or compact bone.

Since the resorptive and replacement processes may go on at the same time or may alternate, a multiplicity of changes were observed. It is because of these findings that the term intermittent resorption of tooth is suggested. When there is a perforation, epithelium may proliferate into the soft tisue of the "granuloma" from either the gingival tissue if there is a cervical lesion or from rests in the periodontal membrane if a lesion occurs in the root.

From this study it appears that in most instances the resorptive process starts from the periphery. From there it extends into the tooth, resorbing the cementum and dentin, channeling them in fingerlike projections or scooping out a large region in the form of a cup. The process may be limited to the hard substance without involving the pulp or may extend directly into it. In some of the specimens studied the pulp was entirely unaffected, and the process proceeded in a circle around the pulp without extending into it. In one instance, the pulp was separated from the resorptive process by a thin layer of dentin.

Thus, different portions of the tooth may be affected, and the histologic appearances are varied. In cases of embedded teeth, practically the entire crown of a tooth may be affected, so that only an enamel shell and a layer of dentin protecting the pulp are left. In the tooth shown in Figure 1, h, for instance, the

entire crown has been replaced by cancellated bone, whereas the bone adjacent to the previous resorptive line of dentin is compact.

In the peripheral lesion shown in Figure 2, b, the resorptive lesion occupies almost the complete distal half of the root. Whereas the resorptive process has advanced considerably, there has been almost no replacement activity. The defect near the crown is covered by osteocementum. Epithelial proliferation, extending in from rests in the periodontal membrane or gingival epithelium, appears in the inflammatory connective tissue in the root portion. The dentin on the pulpal wall has been resorbed.

In Figure 2, d, there is a lesion in an embedded cuspid. The entire crown has been replaced by mature, broad trabeculae of bone with a fatty marrow. The bone tissue exhibits well-formed haversian systems. The resorptive defect is covered by the bone substance laid down in direct apposition. Running through the dentin of the crown is an area of a previous dissecting resorptive lesion now filled with bone running at right angles to the dentinal tubules.

In another case which was studied but not included in the present data because it was previously reported by Thoma, the patient, 22 years of age, was affected with hereditary fibrous osteodystrophy. All the teeth showed evidence of spontaneous intermittent resorption; 11 teeth were examined histologically. In 4 instances almost the entire root had been resorbed, only to be replaced by osteocementum in a pattern of the previously existing root. In the remaining teeth the resorptive process counteracted the replacement effect, so that there was a quantitative as well as a qualitative loss. The process of resorption was of the lacunar type with large multinucleated giant cells in the resorptive areas. This process occurred not only in the dentin but also in the replacement tissue, the osteodentin. Occasionally extensive areas of resorption were observed with but little apposition of any calcified substances. For the most part the pulps of the teeth remained unaffected. Figure 2, e, shows one of the teeth examined.

DISCUSSION

The resorptive-replacement process must be distinguished from cemental resorption due to environmental influences such as occlusal traumatic effects. These latter lesions are small and limited to the tooth surface; they are repaired by cementum. Spontaneous intermittent resorption must be distinguished also from the idiopathic loss of root, which is accompanied by no repair mechanism. In such cases the teeth become shorter; in some cases the root tip becomes rounded, whereas in others half of the root may disappear and the tooth may be left with a blunted end. Teeth may be resorbed also in the presence of tumors or cysts, but this process likewise has no relationship to the process of spontaneous intermittent resorption.

The most common incidence of tooth resorption occurs in the elimination of the deciduous tooth. When resorption is the main process, it completely counteracts any activity to lay down a new repair tissue. In fact, repair material is rarely observed. Therefore, there seemingly does not exist any causal relationship between the resorption of the deciduous tooth and spontaneous intermittent resorption.

If the deciduous tooth has a pulpal involvement, however, the repair mechanism seemingly is stimulated. In one case studied by the author, a deciduous incisor of a four year old child showed definite root resorption after a blow. The tooth became discolored but was allowed to remain in place until the child reached the age of 6 and the tooth became loose. Microscopic examination revealed pulpitis, root resorption and apposition of a bonelike material against the pulpal wall. Previous resorptive channels were com-

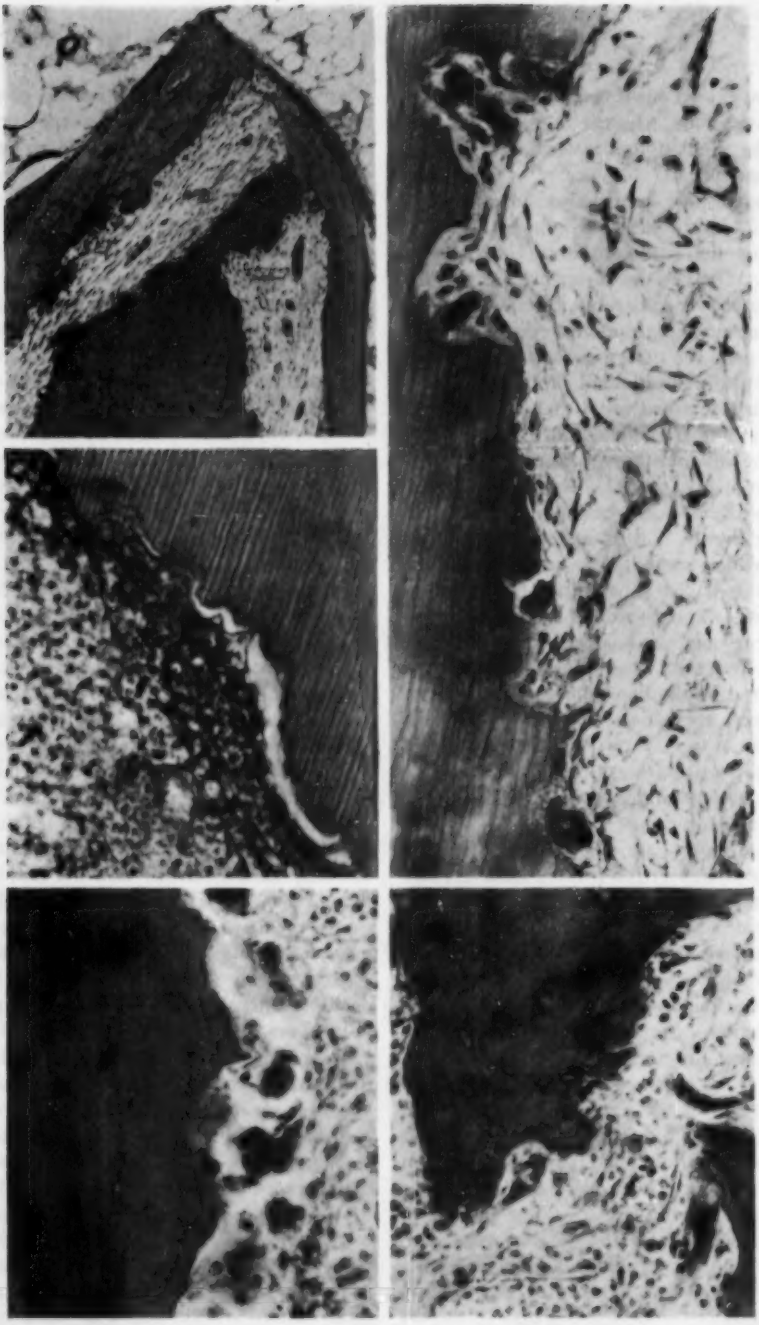

Fig. 3 • Resorptive lesions. Note resorption of dentin in sections, left above, left center, and right above. In lower two sections, replacement tissue is being resorbed by numerous multinucleated giant cells

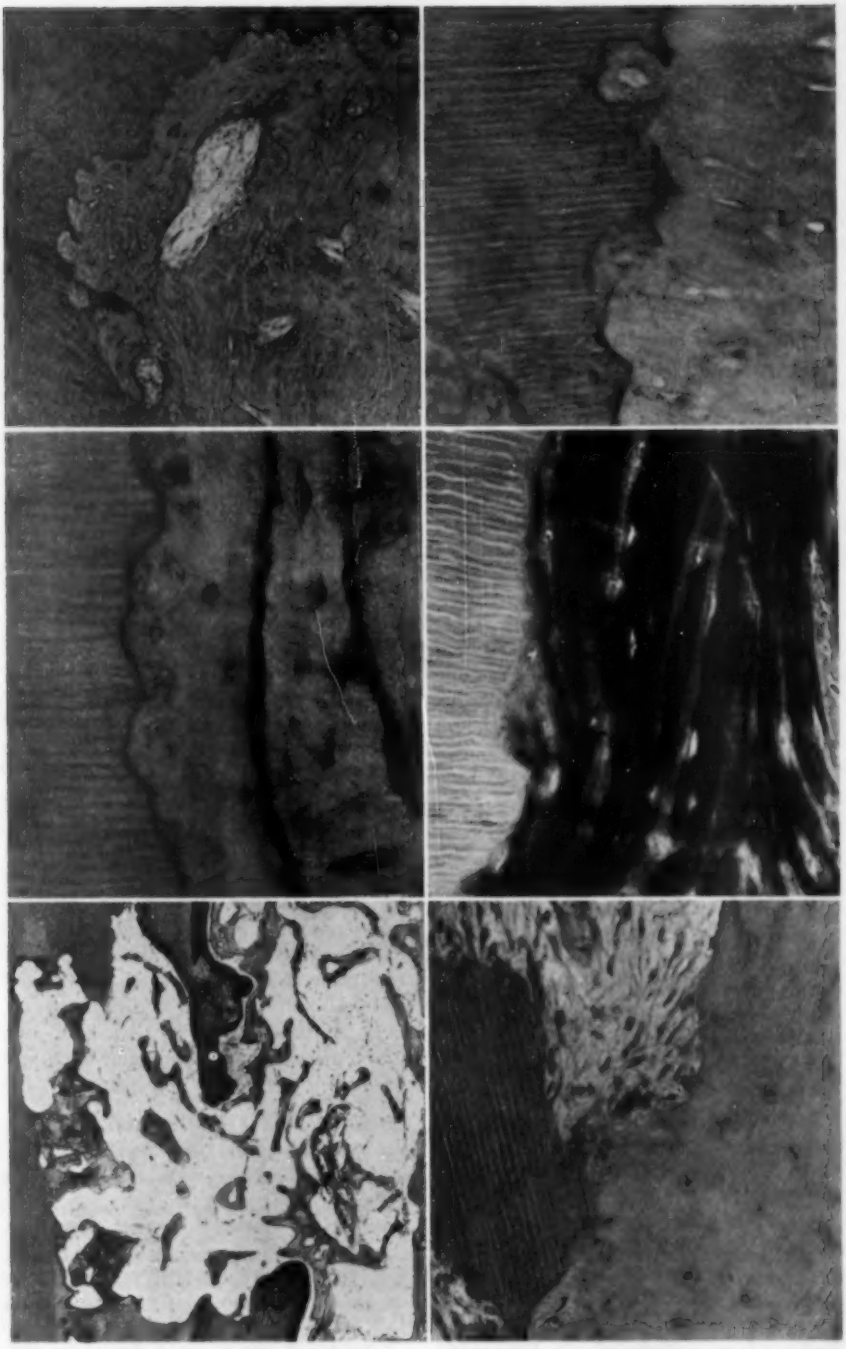

Fig. 4 • Replacement tissues. Above: Cementumlike substance. Center and below right: Compact bone. Below left: Spongy bone

pletely filled with the replacement tissue. It is of considerable interest that despite the presence of the pulpitis the replacement tissue was laid down. It may be possible that the resorptive-replacement process occurred because of the loss of vitality to the tissue.

The relationship of vitality of the dental tissue to the resorptive-replacement disease can be demonstrated by an experiment in which the pulp tissue of a tooth is completely destroyed by coagulation while the electrode is being applied to the pulpal dentin itself. The dentin undergoes a resorptive process with intermittent reparative activity, similar to the process of spontaneous intermittent resorption. Transplanted teeth also are subject to this change. In an experiment conducted by Huggins and McCarroll[2] deciduous teeth were removed from young dogs, the pulps were extracted, and the teeth were transplanted between the muscles of the abdominal wall. These investigators found that the calcified dental tissue became encapsulated with connective tissue and that in "many places a narrow strip of bone replaced the margin of dentin," which had been resorbed. The resorptive-replacement process occurs also when permanent pulpless teeth which have been sterilized are transplanted in the jaw. This process has been demonstrated by Gottlieb and Orban[3] in studies carried out in dogs and also by many clinicians who have replanted or transplanted human teeth.

Fleming[4] reported a process of replacement of dentin in intraocular and brain transplants of tooth germs in rabbits and guinea pigs. Dentin appeared to undergo revision; and as a result of this activity, osteoid tissue or osteodentin was formed. Most of the dentin in transplants lost its characteristic tubular appearance as the revision progressed. The rate and extent varied; but even after a period of a year in certain transfers all the tooth structure had not been entirely rebuilt. Frequently in other instances, however, all the tooth structure had been replaced by osteodentin.

Fleming[4] reported as follows concerning the blood supply in the transplants of tooth germs:

> After a period of growth, transplants of tooth germs received a steadily decreasing blood supply, which was not usually increased except for a short time during the terminal stages of pregnancy. Apparently where collagen fibers, matrix, and cement substance are participating in the elaboration of dentine under favorable conditions the equilibrium is toward the synthesis of dentine. Many factors are involved which aid in maintaining this equilibrium among which Wolbach identifies vitamin C. As growth of tissue progresses the diminishing blood supply may limit the amount of essential factors including vitamin C, which are necessary for growth. Thus the equilibrium may then be shifted away from the formation of dentine to that of a less dense structure which simulates bone.

It appears, therefore, that teeth are resorbed if the vitality of the tissue has been impaired and that in such instances there is reparative activity. It seems likely that the impairment of the vitality is due to local influences such as infection or necrosis of the dental tissue or deprivation of normal metabolism.

The vitality of a single tooth, or of all the teeth, likewise may become impaired by some systemic disturbance. Mueller and Rony[5] and also Kronfeld and Mueller[6] described spontaneous intermittent resorption in the teeth of an 18 year old girl who suffered from a disturbance of liver function. Over a period of two years, several intact permanent teeth had undergone extensive resorption of the

2. Huggins, C. B., and McCarroll, H. R. Apositional substitution of dentin by bone. J. D. Res. 14:174 June 1934.

3. Gottlieb, Bernhard, and Orban, Balint. Die Veränderungen der Gewebe bei übermässiger Beanspruchung der Zähne. Leipzig, Georg Thieme, 1931.

4. Fleming, H. S. The osteogenic tendency of dentin after formation in tooth germ transplants. Oral Surg., Oral Med. & Oral Path. 6:1315 Nov. 1953.

5. Mueller, Emil, and Rony, H. R. Laboratory studies of an unusual case of resorption. J.A.D.A. 17:326 Feb. 1930.

6. Kronfeld, R., and Mueller, E. Ein Fall von generalisierter Zahnresorption. Ztschr. f. Stomatol. 29:276 March 1931.

root. The replacement activity was minimal in all the teeth; although there were numerous osteoclasts, there was only slight evidence in some regions of a reparative process producing a cementumlike material. Both crown and root portions were affected.

A similar case of a 22 year old woman afflicted with hereditary fibrous osteodystrophy was reported by Thoma.[7] Ten teeth were studied, all of which showed extensive resorption-replacement activity. In contrast to the preceding case, replacement of the entire root of the tooth with trabeculated osteocementum material was noted in all the teeth studied. In these teeth the replacement process was extremely active although the resorptive process must have been equally as active previously. For the most part, the teeth, surrounded by connective tissue, remained separated from the surrounding bone. In all the other cases examined, however, the replacement tissue was continuous with the bone trabeculae of the adjacent spongiosa.

The resorption-replacement process occurs not only in the teeth of the jaws but also in teeth of teratomas. The process is identical. In 12 cases of teratomas studied by the writer, the resorptive lesion appeared frequently. The possibility of biochemical influences calls for further investigation.

The initial site of spontaneous intermittent resorption of teeth is related to its pathogenesis. There are two possibilities of origin: (1) The resorption may originate from the pulpal side, involving the hard structure outward. (2) The resorption may begin externally, affecting the tooth surface and proceeding inward. Thorough examination of the gross specimen and roentgenographic and histological examination lead to the conclusion that if the tooth is involved almost completely, internally and externally, the site of origin cannot be determined.

In the cases of this study, the point of origin could be ascertained in 48 cases. Seven lesions were classified as of the internal type. Whereas the peripheral lesion was self-evident and no further proof of origin was needed, the internal lesion required examination to determine that there was no point of communication with the exterior of the tooth.

Figure 1, j, shows a lesion which originated internally; Figure 1, k, shows a lesion which originated on the peripheral aspect. From this study it appears that lesions of internal origin originate adjacent to the pulpal wall in association with an inflammation of the pulp tissue in that region. It appears that once the metabolism of the region is interfered with, a resorptive lesion occurs. Then repair activity commences, and replacement tissue apposition is initiated. These conclusions are essentially consistent with those published by Warner and his coworkers,[8] who in a case of pulpitis extending throughout the tooth observed a resorptive lesion in the apical third of the root canal with multinucleated giant cells in baylike depressions in the dentin.

The variation in pattern of spontaneous intermittent resorption is due to the varying degrees of resorption and replacement and to the rapidity of alternation of these processes. Not only does the dentin undergo resorption, but the replacement tissue—osteocementum, compact bone and cancellated bone—is affected as well. Trabeculae of bone may be lined by osteoblasts on one surface while another surface may show evidence of resorption. Occasionally remnants of tooth structure are completely embedded in the replacement tissue, and a surface of this region may undergo resorption up to a point where both the tooth tissues and the

7. Thoma, K. M.; Sosman, M. C., and Bennett, G. A. An unusual case of hereditary fibrous osteodysplasia (fragilitas ossium) with replacement of dentine by osteocementum. Am. J. Orthodont. & Oral Surg. (Oral Surg. Sect.) 29:1 Jan. 1943.

8. Warner, G. R., and others. Internal resorption of teeth: interpretation of histologic findings. J.A.D.A. 34:448 April 1, 1947.

replacement tissues are exposed. These processes account for the variable patterns which occur.

This study included data on the occurrence both of caries and of spontaneous intermittent resorption. Although many of the teeth studied were carious or had fillings, there seemed to be no relationship between the two processes. Usually the carious lesion was situated on a different portion of the tooth, and there was no connection between it and the resorptive process.

The relationship between pulp involvement and the internal type of spontaneous intermittent resorption needs further study. Certainly the region involved, for the most part, shows evidence of an inflammatory infiltrate, suggesting a close relation between inflammation and the resorptive lesion. This relation is not apparent in the external type of resorption where the region of involvement does not necessarily show any degree of inflammatory change.

SUMMARY

Seventy-six teeth in 73 cases of spontaneous intermittent resorption of tooth tissue were studied clinically. Sixty-three of these cases were examined histologically. The point of origin of the lesion was ascertained in 48 cases; 7 lesions were classified as of the internal type. The variation in pattern of this disease process is due to varying degrees of resorption and replacement by cementum or bone tissue and the rapidity of the alternation of these processes. In the internal type of lesion there is a possibility that the viability of the tooth plays an important role, as it may also in the peripheral type. The resorptive process is commonly observed also in teeth formed in teratomas.

The Furtherance of Science • To foster research of immediate practical value at the cost of exploratory research has consequences not unlike the squandering of natural resources. Both impair the welfare of future generations. We who have benefited so richly from the discoveries of our predecessors have an obligation to our successors. As scientists we can fulfill that obligation by pushing forward our explorations on the frontiers of knowledge, for the achievement of material objectives, as did Pasteur, or merely in the quest for knowledge, as did Faraday.

Too great emphasis on research that is of present value has a harmful influence on the education of scientists. It encourages training for immediate useful service at the expense of education which is a foundation for continued intellectual growth and ultimate competence to solve unanticipated problems of the future. It fosters undue specialization.

If those who support science think the goal of science to be quick answers to practical questions, scientists will be trained for limited objectives. As society accepts the responsibility for supporting more scientists, more men and women will be recruited who are content to fit themselves for a small sphere of scientific action. There is useful work for them to do, and organized research will undoubtedly increase their usefulness. But if the quality of scientific training is determined by the needs of those who are content to be mere technicians, those who would be more will suffer. *Detlev W. Bronk, "The Role of Scientists in the Furtherance of Science," Science 119:225 February 19, 1954.*

Periodontics in general practice

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Healthy periodontal tissues are the foundation which must be the basis for all dental measures to rebuild and repair after damage has been caused by dental disease. Periodontics, therefore, has a major role in the therapeutic and preventive phases of dentistry and should be practiced by every general practitioner. Only thus will it be possible for the profession to alter the present statistics which reveal the exceedingly high incidence of periodontal disease.

Epidemiological studies[1,2] of periodontal disease have shown that nearly 80 per cent of adults and over 20 per cent of children have inflammatory lesions, varying in degree from marginal gingivitis—localized or general—to the more severe periodontitis simplex and complex. Figure 1 is an example of cases, all too common, where chronic gingival inflammation spreads from the gingival crest tissues into the marrow space of the interdental bone, causing resorption of the bone. Unfortunately periodontal lesions are so common that many dentists consider them "normal"—unless they are advanced—and do not try to correct them until the damage is severe and obvious even to the patient.

Most periodontists have been asked by the patient referred to them, "How long have I had this condition?" The resorption of the alveolar crest in cases of chronic periodontitis simplex is usually slow enough that the lesion could have been present for a few years. To be able to detect the pathological condition quickly, first of all the practitioner must have a thorough knowledge of normal histology[3] and physiology of the mouth. The common periodontal lesions[4] occur as inflammation, which is a cellular and biochemical reaction to a mechanical, bacterial, chemical or traumatic injury. The inflammatory process is a reversible reaction; the affected tissue can be restored to normal condition by removal of the etiological factors. Sir William Osler's oft quoted statement that "the practice of medicine is in relation to the knowledge of pathology" may be applied to dentistry. With a knowledge of pathology, the horizon of dentistry becomes unlimited.

In another study it was shown that 65 per cent of adult patients have lost their teeth through periodontal disease.[5] This high percentage is evidence of the necessity of giving an important place to periodontal treatment in the dental care of

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1. Merritt, A. H. Periodontal diseases, ed. 3. New York, Macmillan, 1945.

2. Marshall-Day, C. D. Epidemiology of periodontal disease. J. Periodont. 22:13, 59 Jan. 1951.

3. Orban, Balint. Clinical and histologic study of the surface characteristics of the gingiva. Oral Surg., Oral Med. & Oral Path. 1:827 Sept. 1948.

4. Menkin, Valy. Modern concepts of inflammation. Science 105:538 May 23, 1947.

5. Brekhus, Peter J. A report on a statistical investigation on the loss of human teeth. J.A.D.A. 15:679 April 1928.

a patient. It shows also that if a proper balance is to be maintained in the curriculum of the dental schools, a higher place must be given to the study of periodontal treatment.

The American Association of Dental Schools is aware of this problem and devoted the entire March 1954 meeting in Philadelphia to the status of periodontics in the dental curriculum. The high rate of loss of teeth because of periodontal disease can be lowered considerably if proper treatment after correct diagnosis can be instituted before the periodontal support is undermined. It must be admitted that extraction of teeth and replacement with restorations is too often the procedure of dentists who are unable to treat the pathological conditions that are present. Furthermore, there are dentists who avoid giving periodontal treatment because it may require long periods of treatment.

RESPONSIBILITY OF THE INDIVIDUAL DENTIST

The preventive aspects of dentistry in which periodontics plays a major role must be preached and practiced if dentistry is to fulfill its proper function and reach its proper status in public health.

Detection of Periodontal Disease • The detection of periodontal disease is the responsibility chiefly of the dentists in general practice. They see the majority of patients. They must recognize the clinical and roentgenographic characteristics of both normal gingiva and inflamed gingiva. They must decide whether to treat a patient or to refer him to a periodontist for treatment.

The dentist in general practice must realize that at least half of the inflammatory lesions are caused by overhangs, improper contacts and contours, inadequate removal of calculus and other factors resulting from dental work. The research in periodontics and in histopathology, the leadership provided by the American Academy of Periodontology and similar organizations, and improved instruction in the dental schools no longer allow the dentist to give the excuse that "pyorrhea is incurable." It is the responsibility of every practicing dentist to keep abreast of advances in periodontics and to incorporate improved technics into his practice.

Ordinary clinical and roentgenographic examinations are not sufficient to detect periodontal disease; every means must be used to make the examination thorough. The dentist must use the periodontal probe carefully, he must analyze occlusal dysfunction,[6] he must ascertain loose or open contacts and determine the mobility of the teeth. He must say "close" and examine the occlusion as frequently as he says "open" to view the internal areas of the mouth. Mobility is due to inadequate bone support, to traumatism or to an inflammation of the periodontium. If an adequate foundation for a tooth is provided, inflammation will be relieved, and stability will be restored.

The summation and correlation of all results of the clinical and roentgenographic examinations make a sound diagnosis possible.[7] The general rule of prognosis in periodontics is that if over half of the supporting bone is present and if there is no clinical furcation involvement of the multirooted teeth, then the prognosis is favorable. Variations in particular regions must be evaluated with regard for all factors, whether local or affecting function.

Instruction of Patient • The instruction of the patient in matters of oral hygiene is the responsibility of the dentist and the dental hygienist and should not be left to the tooth paste advertisements. Each mouth requires prophylactic care

6. Ramfjord, Sigurd. Local factors in periodontal disease. J.A.D.A. 44:647 June 1952.

7. Nuckolls, James, and others. The periodontal lesion. J. Periodont. 21:7 Jan. 1950.

adapted to its particular needs, form and manner of functioning. Instruction in the technic of brushing, type of toothbrush best suited to the needs, and use of adjunctive aids should be given to every patient.

Treatment • A thorough scaling and curettage of the root surfaces of the teeth is a much more difficult operation than most dentists realize, that is, if it is performed so that the ideal results from this therapy are to be obtained. The procedure requires extreme care, manual dexterity, proficiency in instrumentation and more time than is usually delegated to this service. Services, properly rendered, command a commensurate fee. No fee is justified for a quick "polish" if subgingival calculus is left to maintain a chronic inflammatory condition. Conversely, a thorough scaling and curettage requiring one, two or more hours merits a fee comparable to that received for other services compensated on a time basis.

A hypersensitive cervical region of a tooth will always be avoided by a patient in cleansing. The desensitization of this region should be performed to insure better hygiene. A paste of sodium fluoride, glycerin and kaolin, equal parts, is effective if it is applied to the clean tooth in three or four successive appointments. The area is dried; the paste is massaged on the sensitive region of the tooth with on orangewood stick, left for two minutes, then removed with a rinse and by expectoration. Absolute Formalin, 37 per cent, can be applied in a similar manner but must not come in contact with the soft tissue; if it does, it will be extremely irritating.

To insure the health of the supporting tissues and a favorable prognosis—the objectives of all dentistry—except in cases of emergency, prophylactic and periodontal therapy should be the first treatment given to the patient. Once the foundation tissues are healthy, then careful constructive restorative dental work

Fig. 1 • Inflammation which has spread from gingival crest tissues into marrow spaces of interdental bone. (Courtesy of J. P. Weinmann)

should be performed with due consideration for the biological aspects of the case. This is the only logical sequence of work. G. V. Black has stated that a filling must restore the lost tooth structure anatomically and physiologically; that is, it must restore contact and contour, provide a functional form with marginal ridges and spillways, and protect the pulp and gingival tissues at all times.

Occasionally a filling made by the best dentist may have an overhang; but the overhang is detected quickly if bitewing roentgenograms are made routinely before the completion of the treatment as well as at the beginning. Prosthetic or orthodontic appliances should not cause chronic injury to tissues. Both overstress and underfunction are deleterious to the health of the supporting tissues.

Splinting teeth together by means of interlocking inlays, soldered pinlays or multiple abutments increases the life of abutment or adjacent teeth which have

weakened periodontal support.[8] Temporary splinting of loose teeth by wires, ligatures and appliances is necessary to stabilize the teeth to allow healing of the periodontium. The general rules of good restorative dentistry must be obeyed at all times to insure the maintenance of a healthy periodontium. It is a wholesome procedure for every dentist to reflect on the conduct of his practice.

Many times the tissue is already injured before the operation is performed, or it is injured during the operation. Such tissue should not be left to resolve itself or to become chronically inflamed, with oral bacteria adding irritation to aggravate what was first only a mild inflammation (Fig. 2, above left).

When a clamp or any other instrument causes injury, a periodontal pack placed for 24 to 36 hours will insure a major reduction of the inflammation (Fig. 2, above right, and below). Mixed so that its consistency is suitable to the lesion—soft for the acute lesion, more firm for the chronic lesion—the pack is placed on the surface and interdentally for the purpose of sedation and in the region of the pocket for the purpose of sterilization, sedation and displacement of edematous gingival tissue.[9] The most commonly used pack, which can be employed for temporary fillings, surgical dressing, sedation and displacement, and other multiple uses in general dentistry, has the following constituents:

Formula for pack

Powder	%	*Liquid*
Zinc oxide	40	Eugenol 48 cc.
Resin (powdered)	40	Thymol 2 Gm.
Tannic acid powder	15	Oil of sweet almond 2 cc.
Sterilized kaolin	5	
	100	

To these constituents one to two parts by volume of fine asbestos fibers are added.

CAUSES OF FAILURE

Factors that cause failure in the treatment of periodontal disease can usually be avoided. The most common causes of failure are the following:

1. Incorrect treatment. Methods of correct treatment can be learned from texts, professional journals and many other sources. Frequently a method of treatment may be the correct one, but failure arises from errors in application of the method. Other common sources of error are an incomplete history, an inaccurate evaluation of systemic factors and an incorrect diagnosis.

2. Insufficient treatment. Not only must the method be correct, but adequate time must be allowed for the return to normal conditions after treatment. Inadequate results may be produced by the failure to "follow through" in treatment, to make proper rechecks and to obtain cooperation from the patient. Unsatisfactory results may be due also to the dentist's inability to detect all the etiological factors or to his failure to employ therapeutic treatment to eradicate them after he has detected them correctly.

3. Treatment of advanced cases. There are cases which are so advanced that any treatment would result in failure.

4. Inadequate home care. Adequate home care is a "must" in periodontal treatment. Sometimes psychosomatic therapy may be necessary, since hygiene requires a healthy state of mind as well as ideal oral and body cleanliness.

5. Lack of proper follow-up examinations. Regular rechecks are essential

8. Hirschfeld, Leonard. The use of wire and silk ligatures. J.A.D.A. 41:647 Dec. 1950.

9. Williams, C. H. M. Rationalization of periodontal pocket therapy. J. Periodont. 14:67 July 1943.

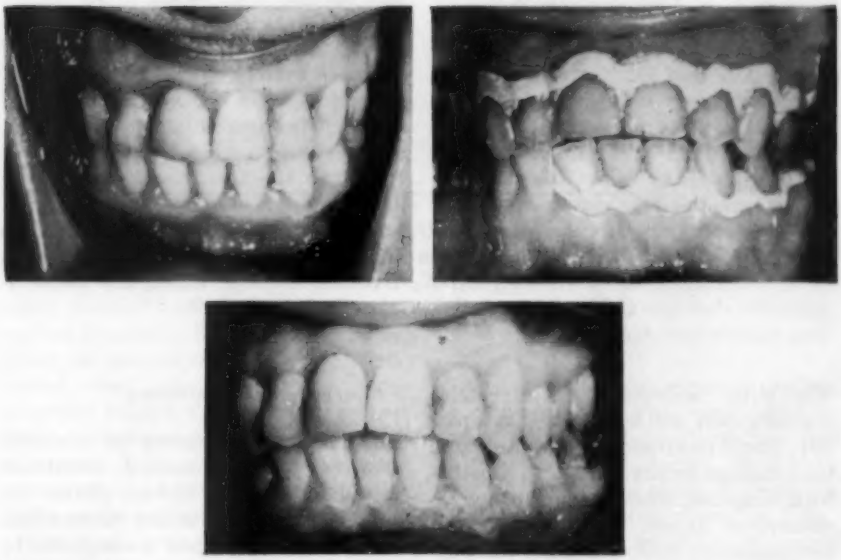

Fig. 2 • Case of severe marginal periodontitis simplex. Above left: Before treatment. Above right: Periodontal pack applied for displacement and sedation. Below: Three weeks after treatment. New porcelain jacket has been placed. Tissues are now normal

to the maintenance of prophylactic and preventive care.

6. Ignorance on the part of the patient. Education of the patient in the value, objectives and status of periodontics in dentistry is the privilege of every dentist, but first of all he himself must be fully versed on these aspects of dentistry.

CONCLUSION

The present high incidence of periodontal disease can be reduced to an exceedingly low rate if the general dental practitioner is equipped with knowledge of the advances in modern dentistry and if he applies that knowledge by employment of proper preventive and therapeutic periodontal treatment.

Benefactors • Those authors into whose hands nature has placed a magic wand, with which they no sooner touch us than we forget the unhappiness in life, than the darkness leaves our soul, and we are reconciled to existence, should be placed among the benefactors of the human race. ***Diderot.***

Leukoplakia

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The term "leukoplakia" is acceptable etymologically and semantically as a partial clinical description of a whitish area on a mucous membrane, but as a pathologic diagnosis there is good reason to discontinue its use. There is no precise histopathologic entity which is accepted by any great percentage of workers as being "leukoplakia." The varied interpretations of this term as a clinical and pathologic diagnosis have contributed to inadequate management of lesions that eventually are diagnosed as epidermoid carcinoma.

Biopsy reports regarding lesions of this type should be couched in terms applicable to the microscopic findings. The agony involved in the estimated 6,000 oral cancer deaths per year is almost beyond comprehension; if a clarification in terminology would reduce the possibility of error in treatment planning, there would seem to be little to be said against the proposal.

Manifestly, the prime concern lies in the group of whitish lesions which are the clinical expression of disorders in maturation of the oral epithelium; for the diagnosis of these cases, microscopic evidence is essential. The choice of lesions to be studied in this manner rests on the ability of the practitioner in differential diagnosis—this is not a plea for the indiscriminate biopsy of every whitish area observable in the mouth.

DIFFERENTIAL DIAGNOSIS

The differential diagnosis of a whitish area on the oral mucous membrane should include case history, clinical examination and observation, bacteriologic studies if pertinent, and investigation by biopsy of every persistent lesion that cannot be identified positively by other means. Biopsy at intervals is imperative in the management of any long-standing disorder of the oral epithelium regardless of the initial diagnosis.

Obtaining and recording the symptoms, duration, clinical course, and the patient's conception of possible etiology is time well spent, and, in some instances, almost enough data will be obtained for the formulation of the diagnosis. A history of the use of acetylsalicylic acid in the buccal fold would certainly indicate a short period of observation; a painful area would eliminate the probability of a primary syphilitic lesion; repeated occurrence and remission might suggest herpes or aphthous stomatitis; prolonged painless duration without remission and with but little change might point to lichen planus, and so on. The experienced clinician will be better able to make a significant observation on the basis of the history than could be hoped

From the Colorado Dental Foundation, Colorado Springs, Colo.

for by one of less acumen, but the case history is an essential first step in arriving at any diagnosis.

Chronologically, the clinical examination should follow the history, although in importance it is not outranked by any diagnostic procedure. No portion of the oral cavity should escape visualization and palpation. Many a helpful hint will come from an appraisal of regional lymphadenopathy, dermatologic lesions, elevations in body temperature, and any other physical finding of which the examiner is capable. The description of the lesion in question should include distribution, size, color, consistency, topographical relation to surrounding normal tissue, and the character of the exudate if present. With attention concentrated on regions which could be described clinically as "leukoplakias," the color of the lesion is of primary interest. The sign of second importance is that of the topographical character. To confine differential diagnosis to disorders in epithelial maturation, the whitish lesion should be so closely examined as to rule out the possibility of its being either an ulcer or a blister; by this step it is possible largely to eliminate the probability of etiology from pemphigus, erythema multiforme, herpes, and syphilis.

Coagulation of surface tissue by physical or chemical agents (cautery, trauma, zinc chloride, silver nitrate, tobacco, acetylsalicylic acid, and so on) produces a whitish area on the oral mucous membrane that should be identified readily either in the course of obtaining the case history or by a short period of observation. These lesions are characterized clinically by the ease with which the coagulum may be wiped off and by the rapid rate of recovery which follows cessation of further injury.

Both syphilis and yaws may produce bluish white lesions, but the surface of such lesions is not readily peeled off. Bacteriologic or serologic confirmation should be sought if the history lends any weight to the possibility of a venereal disease as the etiologic factor. Regional lymphadenopathy would increase the probability of syphilis, but, at the same time, would suggest inquiry into the possibility of infectious mononucleosis.

There should be no clinical confusion between the easily removable greyish pseudomembranes of diphtheria or a fusospirochetosis and the classic whitish areas which are the concern of this paper. Etiologically, the pseudomembranes result from infections, and their identification is possible through bacteriologic studies.

A painless, milky-white plaque that can be removed only with some difficulty should indicate a fungoid infection and bacteriologic identification should be sought. The removal of the white plaque of thrush always leaves a bleeding base.

There are at least three recognized disorders of unknown etiology which are of importance in any differential diagnosis of whitish lesions of the oral mucous membrane: lichen planus, psoriasis, and lupus erythematosus.

Lichen planus, in the mouth, is typically lacelike in form, light bluish white in color, and usually is most pronounced in the cheeks, opposite the line of occlusion of the teeth. The only symptom is a sense of roughness or induration when explored by the tongue. This disorder is a dermatologic disease and may present lesions in old scars, on the flexor surfaces of the wrists, the shins, or other areas of the body. Microscopically, lichen planus presents hyperkeratosis and an over-all atrophic epithelium, with an indistinct basal-cell layer. The inflammatory reaction in the underlying connective tissue is characterized by the absence of plasma cells and by the bandlike concentration of lymphocytes closely paralleling the basement membrane.

The very small, white, scaly patches seen in psoriasis may be scraped off easily—the scraping leaves multiple hemorrhagic points of exposed connective tis-

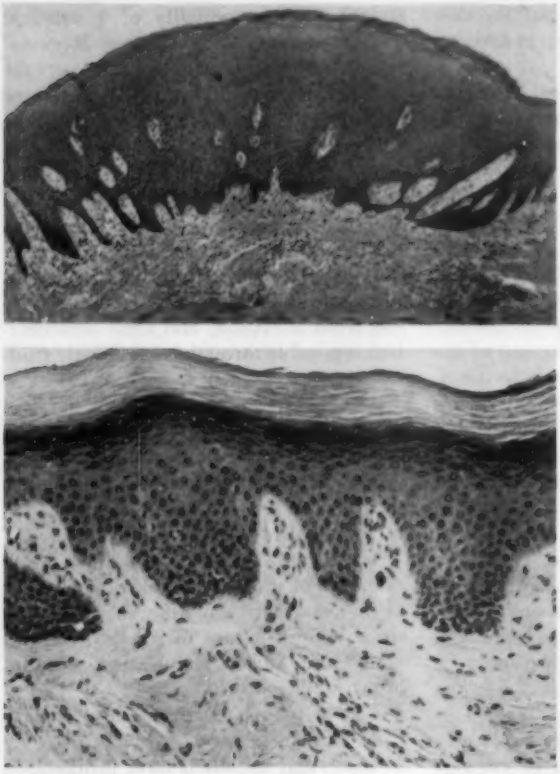

Fig. 1 • Above: Hyperplasia. Below: Hyperkeratosis. (Specimen by courtesy of George J. Revis)

sue which present a typical clinical appearance under magnification. The restricted distribution of the lesions permits an almost certain differentiation from lichen planus. Microscopically, psoriasis is a parakeratotic hyperkeratosis with a typical inflammatory response in the connective tissue.

Lupus erythematosus is principally a connective tissue disorder, but in its course forms small whitish epithelial scales which are soon lost, leaving small erosions. Early lesions are painful. A butterflylike lesion is sometimes seen on the face over the nose and malar areas. The microscopic appearance is that of hyperkeratosis in the epithelium and degenerative changes in the connective tissue.

DISORDERS OF EPITHELIAL MATURATION

At this point it can be assumed that, through the processes involved in differential diagnosis, the whitish lesion in question has been presumed to be a disorder in the maturation of the epithelium and that a biopsy specimen has been obtained. A simple classification for maturational disorders in the epithelium of the oral mucous membrane will be presented, accompanied by typical sections to illustrate the histopathological characteristics. In this way a discussion of what "leukoplakia" is microscopically is eliminated; the seemingly interminable dissension as to whether "leukoplakia" is benign, pre-

cancerous, or cancerous can be avoided; and, most important of all, a basis for a rational plan of case management is provided.

The classification is as follows:

1. Hyperplasia
2. Hyperkeratosis
3. Hyperkeratosis and inflammation
4. Hyperkeratosis, dyskeratosis, and inflammation
5. Intraepithelial cancer
6. Epidermoid carcinoma

Hyperplasia (Fig. 1, above) implies a simple overgrowth. The specimen selected for illustration is from an elevated, sharply circumscribed, whitish area, 0.5 cm. in diameter, on the labial gingiva of a mandibular cuspid in a tumor-conscious patient. Microscopically, it is obvious that the whitish clinical appearance was due to a prickle-cell layer so increased in thickness as to obscure the normally pink connective tissue. The specimen shows no hyperkeratosis, no inflammation, no dyskeratosis, no suggestion of invasiveness.

Hyperkeratosis (Fig. 1, below) is demonstrated in a specimen from the gingiva in the bicuspid area on the lingual surface of the mandible of a 36 year old man, a moderate smoker, with no significant history or systemic findings. Extensive whitish lesions were noted on both cheeks, the lingual surface of the mandible, the floor of the mouth, and the ventral surface of the tongue. Microscopically, the most prominent feature is the greatly increased thickness in the keratin and granular layers. The prickle and basal cell layers are normal in appearance, and the epithelial ridges show the customary uniform configuration. There is no inflammatory re-

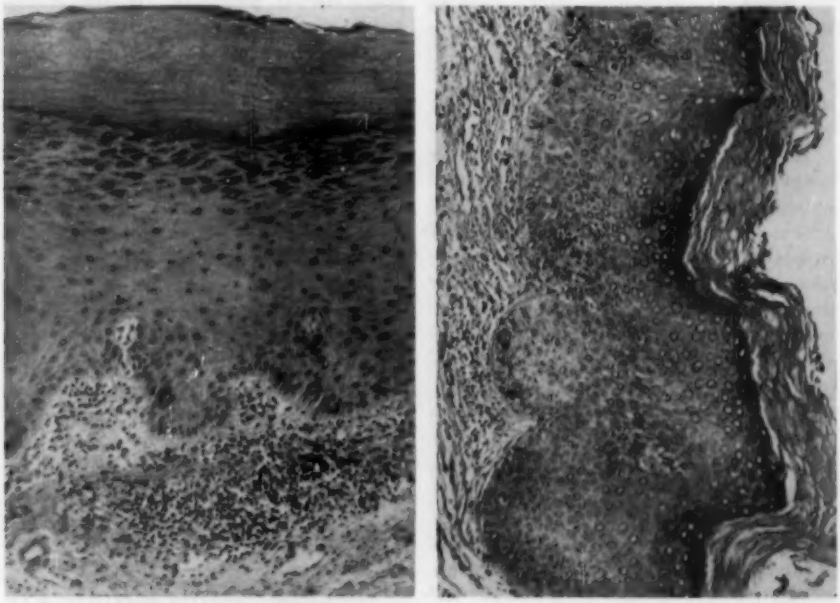

Fig. 2 • Left: Hyperkeratosis and inflammation. (Specimen by courtesy of G. P. Ivancie). Right: Hyperkeratosis, dyskeratosis and inflammation. (Specimen by courtesy of Harold E. Grupe)

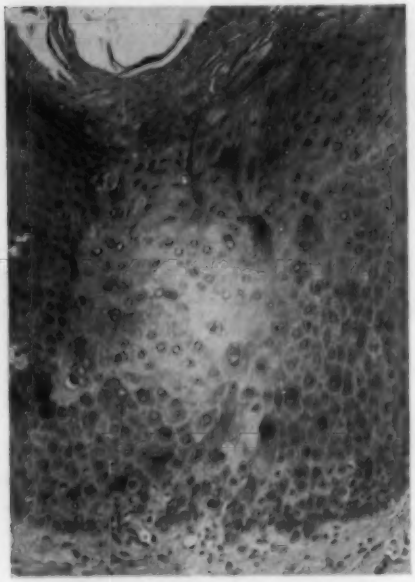

Fig. 3 • Intraepithelial cancer. (Specimen by courtesy of Norman E. Shultz)

sponse, no dyskeratosis, and no suggestion of epithelial invasiveness.

In microscopic sections many whitish areas on the oral mucous membrane show hyperkeratosis and an inflammatory reaction (Fig. 2, left) in the subepithelial tissues. This group is of special importance for it includes lichen planus. The illustration shown is from a specimen obtained by biopsy from a young man whose cheek-biting habit had produced an extensive whitish lesion. Although not normally present in the cheek, both keratin and granular layers are prominent in this specimen. The prickle-cell layer exhibits acanthosis but no dyskeratosis. The basal-cell layer is generally regular. In the connective tissue the lymphocytic and plasma cell infiltration is typical of an inflammatory response of moderate intensity.

Many disorders in epithelial maturation belong microscopically in a class characterized by hyperkeratosis, dyskeratosis, and inflammation (Fig. 2, right)—the dyskeratosis being the critical denominator. The case illustrated is from a whitish lesion on the left side of the soft palate of a 40 year old woman with no significant history or medical findings. The lesion was rough on the surface, irregular in outline, slightly elevated and approximately 1 cm. in its greatest diameter. Around and within the whitish lesion there were a number of brownish pigmentations. In sections from the biopsy the findings are primarily an extensive, very irregular hyperkeratosis and a heavy granular layer. The entire epithelium is somewhat acanthotic. The most important microscopic feature is the dyskeratosis observable in the zone of the prickle and basal cell layers; single keratotic cells and giant-sized cells are observable, and in the basal-cell region hyperchromatic nuclei are a prominent feature. These maturational disorders are the microscopic picture of dyskeratosis. The basement membrane is intact. In the connective tissue the papillae have almost completely disappeared and the lymphocytic infiltration is pronounced.

Hyperkeratosis alone and hyperkeratosis with inflammation should be called hyperkeratosis simplex, but when dyskeratosis appears in the epithelium, the condition should be classified as hyperkeratosis complex.

Intraepithelial cancers (Fig. 3) are typified by hyperkeratosis and an extreme dyskeratosis of cells in the prickle and basal cell zones—extreme to the degree that were it not for the presence of an intact basement membrane, the growth would be indistinguishable from a frank carcinoma. The case illustrated is of special interest because the specimen was obtained from the mouth of a girl 14 years of age.

There is little basis for disagreement on the microscopic appearance of an epidermoid carcinoma (Fig. 4, above left), the all important finding being an unmis-

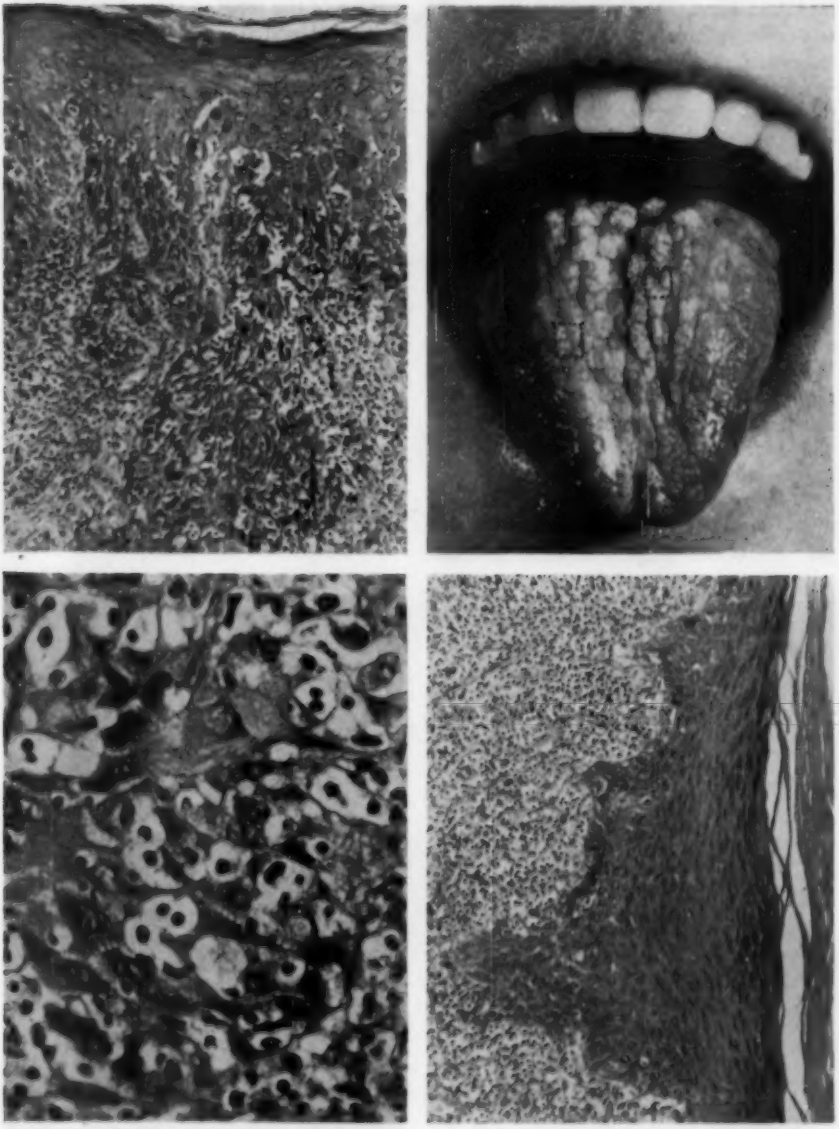

Fig. 4 • Above left: Epidermoid carcinoma. Above right: "Leukoplakia" of tongue. Below left: Epidermoid carcinoma. Higher power view of section from central area of tongue (above right). Below right: Hyperkeratosis, dyskeratosis and inflammation. From lateral area of tongue (above right)

takable invasion of epithelial elements into the connective tissue. Hyperkeratosis is a consistent feature and there is always an extreme dyskeratosis; keratinization is found in all stages and accounts for the numerous so-called horn pearls. The inflammatory response in the connective tissue is characteristically severe.

REPORT OF CASES

The following five cases were selected from a group of 30 examples of so-called "leukoplakia" of the oral cavity submitted for diagnosis by members of the Histopathology Study Club of the Colorado Dental Foundation. In each instance the patient had a previous diagnosis of "leukoplakia" based on either a clinical or a microscopic examination.

A 60 year old woman had a tongue milky-white in color, heavily furrowed, and with numerous whitish patches. The surface of the tongue was not perceptibly indurated and was only slightly rougher than normal (Fig. 4, above right). There was no complaint of soreness and nothing in the history was of note except that two years previously the patient had sought medical advice for a similar condition. After massive doses of vitamin A, the white coating disappeared for a period of about a year. The clinical diagnosis at the time of biopsy was "lichen planus or leukoplakia"; biopsies were taken from the areas as indicated in Figure 4, above right.

The specimen from the lateral area of the tongue showed hyperkeratosis, dyskeratosis and inflammation, but no invasion by epithelium (Fig. 4, below right). On the basis of this biopsy, case management would possibly have been limited to rather frequent surveillance by biopsy.

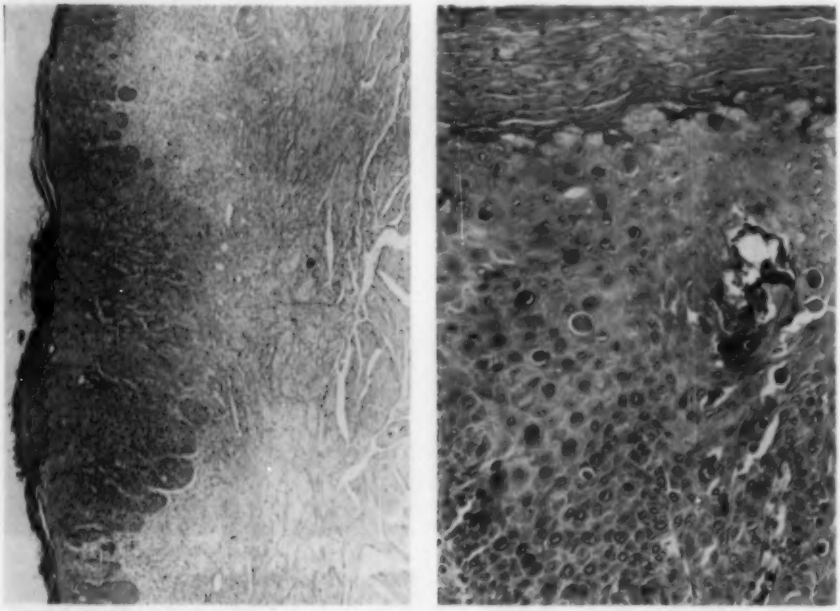

Fig. 5 • Left: Epidermoid carcinoma in early stage of development. Right: Epidermoid carcinoma. Higher power view of section shown at left

The specimen taken from the central area (Fig. 4, above left) was typically malignant in character. Irregular epithelial proliferation had taken place with an accompanying loss of basement membrane and penetration of the epithelial strands into the connective tissue. There was a severe lymphocytic infiltration. The malignant epithelial growth was characterized by wide variations in the size of the cells, by keratinization in the form of epithelial pearls, and by nuclei ranging from hypochromatic to hyperchromatic (Fig. 4, below left).

Although a careful clinical examination at the time of biopsy revealed no regional lymphadenopathy, and against the surgeon's judgment, the entire affected surface of the tongue was removed. The excised tissue was thoroughly examined microscopically, but in no section could a diagnosis of carcinoma be established. The pathologic diagnosis was "leukoplakia," characterized by hyperkeratosis, dyskeratosis, and inflammation. Three months after the partial glossectomy, the patient developed an enlarged gland in the neck. The pathologist's report on tissue removed in a complete neck gland dissection was an unquestionable malignancy. The patient suffered an extensive recurrence of the tongue lesions, and succumbed to cachexia from multiple metastatic lesions in February 1953, less than one year after the initial biopsies.

The second case is that of a 60 year old woman who came for treatment because of a sore spot under the lingual border of an artificial mandibular denture. Clinically, the area was in no way unlike any other chronically traumatized tissue: it was whitish in color, slightly elevated, irregular in outline, and sensitive to palpation. The portion of the denture judged to have caused the injury was removed and the patient dismissed. At the end of two months the woman returned, obviously concerned that the same area should still be troubling her. Again the lesion was judged to be a simple traumatic injury, and treatment was limited to further relief of the pressure. The tumor-conscious patient finally visited a cancer clinic where the lesion was surgically removed, but with a clinical diagnosis of inflammatory granulation. The microscopic picture (Fig. 5, left), was that of epidermoid cancer. The superficial layers of the epithelium were thick and parakeratotic and nowhere could the granular layer be identified. The prickle-cell showed considerable dyskeratosis; the cells showed a great variance in size and were alternately keratinized or hyperchromatic (Fig. 5, right). Toward the basal-cell layer, cell arrangement was extremely irregular and numerous mitotic figures were observable. The border between epithelium and connective tissue was very indistinct. Some epithelial projections exhibited pearl formation. The

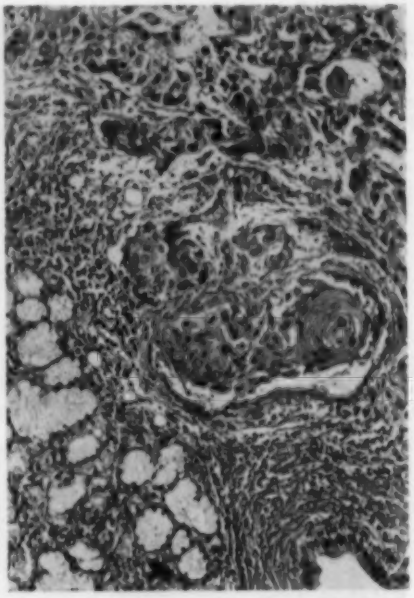

Fig. 6 • Epidermoid carcinoma invading sublingual tissue. (Specimen by courtesy of Charles R. Thompson)

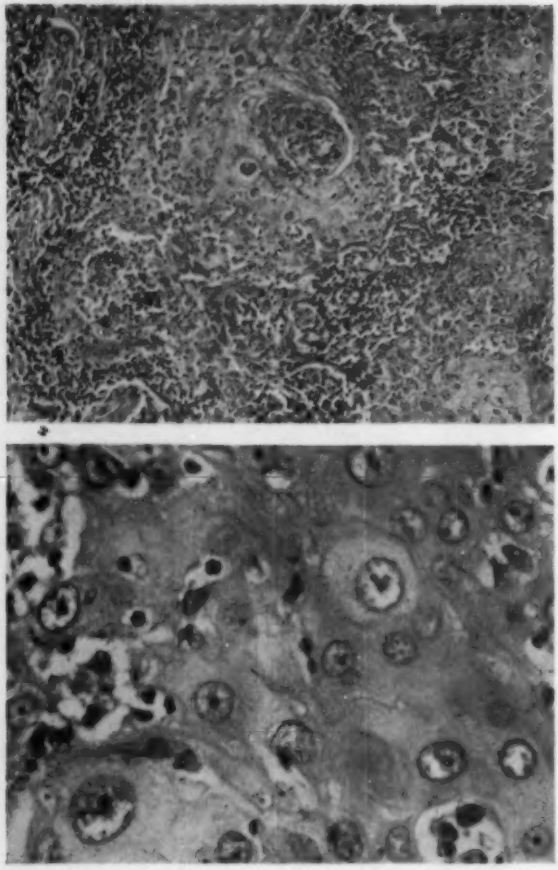

Fig. 7 • Above: Epidermoid carcinoma. Below: Epidermoid carcinoma. Higher power view of section shown above

connective tissue was densely infiltrated with lymphocytes and plasma cells.

A small, smooth, elevated, painless white area under the tongue prompted a 51 year old man to report to an oral surgeon for consultation. At biopsy the clinical impression was that of a benign ulcer, with malignancy an unlikely possibility. The microscopic examination showed an epidermoid carcinoma infiltrating into a sublingual gland (Fig. 6). The cancer cells were irregular in size, in shape, and in staining reaction; no basement membrane was present.

In the next instance there was a painless, heavy white patch, about 4 cm. in diameter, on an edentulous mandibular ridge. The patch extended into the vestibulum of a 71 year old woman who was a snuff addict. Two years previously there had been a microscopic diagnosis of "leukoplakia." The biopsy specimen showed this lesion to be a verrucous type of carcinoma with circumscribed areas of heavy epithelial thickening and club-like epithelial ridges that penetrated deeply into the connective tissue. The border between epithelium and connec-

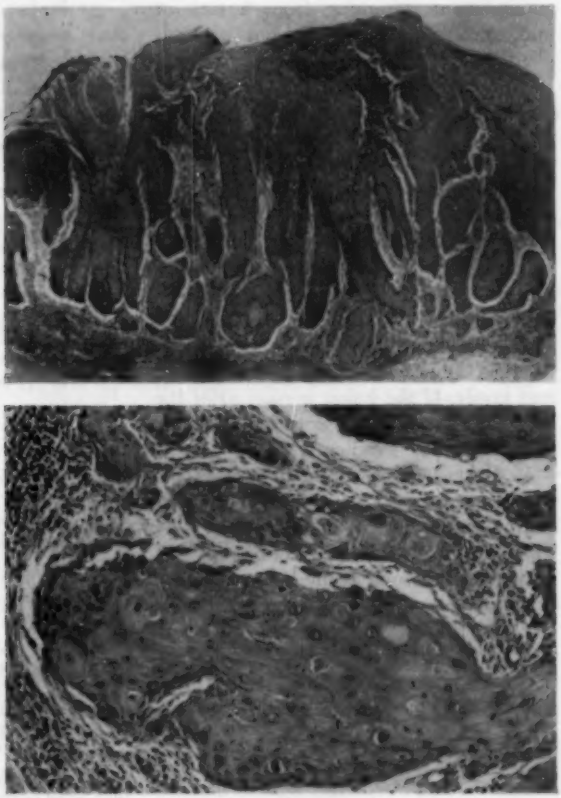

Fig. 8 • Above: Verrucous type of epidermoid carcinoma. Below: Epidermoid carcinoma. Higher power view of section shown above. (Specimen by courtesy of George G. Ingham)

tive tissue was indistinct; inflammatory cells had migrated into the epithelium (Fig. 7, above); the basal-cell layer was wide and irregular. Some epithelial cells were extremely large (Fig. 7, below).

A case comparable clinically as well as microscopically to that just described was found in a 56 year old man who also had had a clinical diagnosis of "leukoplakia" a year previously, and had been advised to keep the area under observation. At biopsy the lesion appeared as a heavy, granulomatous, cauliflowerlike, white growth on the right side of the mandible in the cuspid area. Similar, but smaller, white patches were found on a maxillary tuberosity and on the soft palate. This verrucous epidermoid cancer (Fig. 8, above) showed typical dyskeratosis and epithelial islands that penetrated deep into the connective tissue (Fig. 8, below). The lesion in the lower jaw was surgically removed, and the remaining lesions were fulgarized by electrocautery.

DISCUSSION

The only proof necessary to support the statement concerning the lack of agreement on the histopathologic entity of "leukoplakia" is to be found in the literature listed in the bibliography.

The cases presented herein are typical of our experience with inadequate case

management stemming from a lack of understanding of exactly what was implied by a diagnosis of "leukoplakia."

There is no evidence that epidermoid cancer must evolve by progression through a series of seemingly innocuous epithelial maturational disorders, nor is there any proof that a hyperkeratosis with inflammation and dyskeratosis is sure to become malignant.

From a case management standpoint, the patient who has a hyperplasia or a hyperkeratosis without dyskeratotic changes (hyperkeratosis simplex) is entitled to the peace of mind that such findings imply. If the lesion persists after the elimination of all irritating factors, periodic biopsy is indicated.

If dyskeratosis is found in any microscopic section of a lesion (hyperkeratosis complex), the patient should be given the assurance that the biopsy will be repeated periodically as long as the lesion remains, or if the lesion recurs after removal. On the basis of the suggested classification, the lesions in which there is dyskeratosis but which are still limited by the basement membrane are the critical cases. As was just stated, there is no proof of an eventual progression to carcinoma; however, neither patient nor dentist can afford to discount such a possibility. In addition to the elimination of all possible sources of irritation—certainly indicated for any maturational disorder of oral epithelium—the dyskeratotic lesions should be considered for removal.

The intraepithelial cancer and the frank carcinoma require immediate treatment, and no patient should be denied the benefits of prompt and heroic therapy.

Prolonged clinical observation in the absence of an adequate microscopic study is indefensible.

SUMMARY

1. The use of the term "leukoplakia" should be discontinued as a diagnosis.

2. Biopsy is essential in the diagnosis and management of every persistent whitish lesion of the oral mucous membrane that has not been positively identified by other means.

3. A histopathologic classification for maturational disorders in the oral epithelium is suggested.

4. Five cases are presented to illustrate the danger of inadequate case management on the basis of "leukoplakia" as a diagnosis.

30 North Michigan Avenue

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Vaccinia infection in pregnant rabbits and its effect on maternal and fetal dental tissues

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The relationship of maternal disturbances to abnormal fetal development has been the subject of considerable speculation and controversy. Much impetus was given to the study of this subject by the observation of Gregg,[1] who reported a significant number of cases of congenital cataract in the offspring of mothers who had had rubella during the early stages of pregnancy.

Later investigations showed that a number of other congenital defects, such as microcephaly, cardiac abnormalities, deaf-mutism and dental defects, could possibly be attributed to the same cause.[2-6] Although Swan and others[2] in a study of congenital abnormalities in children found no factor in the maternal history other than that of rubella that could be implicated as a causative factor, it was reported later[5] that such other virus diseases as rubeola, mumps, varicella and herpes zoster also are of etiological significance.

That an intrauterine infection may occur in such virus diseases as varicella, rubeola and variola has been suggested by occasional clinical observations.[7-10] More conclusive is the experimental evidence reported relative to the transfer of the virus of lymphocytic choriomeningitis from pregnant animals to the fetal circulation.[11] Similarly, transplacental passage of the virus has been demonstrated in animals infected with Rift Valley fever.[12]

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Of particular interest for the present study is the finding by Blaker[13] of infected fetal tissues in a cow, a buffalo and a rabbit after intradermal inoculation of these animals with vaccinia virus. Douglas, Smith and Price[14] likewise demonstrated the presence of this virus in a fetus of an infected rabbit. It was observed in the same study that three other animals aborted after they had been inoculated with the virus. Unfortunately, no tests were reported for the presence of virus in the aborted fetal tissues.

The mechanism by which congenital abnormalities are produced as a consequence of rubella and other virus diseases in the mother has not been established. Whether they result from an infection of the fetus or from a metabolic by-product of the maternal infection, as suggested by Gillman and his co-workers,[15] remains a question. Regardless of pathogenesis, however, there is general agreement with the contention of Ingalls and Gordon,[16] that a single agent may cause different types of developmental arrest and that unrelated agents may initiate identical abnormalities. In either case, the nature of the defect, or defects, is necessarily dependent on the time of gestation when the agent was present and active.

In clinical studies of the effect of various virus diseases in the mother on fetal dental development, apparently rubella alone has been demonstrated to have a definite etiological relationship. Evans[3] noted that abnormalities such as retarded eruption, restricted arch formation and hypoplasia are caused by this factor. Since disturbances in the highly specialized function of odontogenesis would be indicative of a fetal response to adverse maternal influences, further investigation of this question seemed advisable. This was especially true since it appeared that no such experimental study with viral organisms had been reported in the literature.

MATERIALS AND METHODS

The following were the prerequisites for the conduct of this study: (1) a virus capable of producing a generalized infection in a common laboratory animal whose placental structure is similar to that of man, (2) a disease, produced by the virus, with a blood phase which would provide an opportunity for placental passage of the virus and (3) reliable methods for isolation and identification of the microorganism.

Additional considerations in the choice were the size of the virus and the ease and safety in handling it. Of several viruses that satisfied most of these requirements, the virus of vaccinia was selected in spite of its large size and the possibility of secondary infection of cutaneous lesions. The most significant advantages afforded by this virus are: (1) it is probably the best defined of animal viruses;[17] (2) it is safely handled and easily isolated and identified; (3) it produces in rabbits a generalized disease with a blood phase;[18-20] and (4) it has been reported to cause intrauterine infection.[13,14]

The rabbit was the experimental animal of choice because of its well-established susceptibility to vaccinia, the simi-

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larity of its placental structure to that of man[21,22] and the ease with which blood samples can be taken. Since previous studies had demonstrated that the rabbit fetus has a greater susceptibility to the virus of vaccinia than the adult,[23] it was considered probable that if the placenta is permeable a virus titer eliciting a minimal response in the mother would cause a generalized infection in the fetus.

The seed virus used in the first part of this study was supplied by the Army Medical Department, Research and Graduate School, which in turn obtained it from a strain supplied by the New York City Board of Health and adapted it for egg passage.

It was maintained by passage on the chorioallantoic membranes of embryonated eggs, with the window method[24] used for inoculation. After incubation for 48 hours at 37° C., the infected membranes were stored in 50 per cent neutral glycerin at 4° C. As they were needed for inoculation, the membranes were ground with sterile alundum in physiological saline solution; and the resulting virus suspension was fortified with penicillin, 1,000 units per milliliter, and streptomycin, 1,000 micrograms per milliliter.

One milliliter doses, varying in titer from 10^{-4} to 10^{-6}, were administered to each animal via the marginal ear vein. This relatively light dose was selected arbitrarily in view of a previous report on the frequency of abortion in rabbits with severe vaccinia infection.[14] Blood samples, consisting of washed cells, taken immediately before and from 2 to 7 days after inoculation, were cultured on the chorioallantoic membranes of embryonated eggs to test for the presence of the vaccinia virus.

A total of 46 female California and New Zealand albino rabbits, ranging in age from 6 to 11 months, were studied. In all cases bucks used for breeding purposes were previously demonstrated to be fertile. Of the 33 virgins used in the first part of this study, 14 were injected 6 to 16 days prior to mating and the remainder after mating. The latter animals were grouped so that 12 were inoculated during the first trimester of pregnancy, that is, 1 to 10 days after mating; 4 during the second trimester, that is, 11 to 20 days after mating; and 3 during the third trimester, that is, 21 to 30 days after mating.

In order to follow the progress of possible fetal disturbances, cesarean sections were performed at varying stages of pregnancy on representative animals of each group. In the groups inoculated before breeding and during the first trimester after breeding, cesarean sections were performed on one or more rabbits during each of the trimesters of pregnancy. Similar procedures were followed for those animals inoculated during the second and third trimesters after mating. Other rabbits in each group completed their course of pregnancy without disturbance.

All operative procedures were carried out under aseptic conditions. Anesthesia consisted of intravenous sodium pentobarbital (Nembutal), 40 mg. per kilogram of body weight, supplemented with ether. One or more fetuses in either the left or right distal uterine horns were then removed via a mid-line abdominal incision. After inspection of the viscera, the wound was closed with surgical silk. No special postoperative care was given. In almost all instances, the remaining fetuses were delivered spontaneously at term and were viable. Postmortem examination of animals killed 2 to 11 months after the operation invariably

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Fig. 1 • Typical vaccinial lesions 4 to 5 days after intravenous inoculation of vaccinia virus

showed well-healed sites with few adhesions.

In the process of testing for the presence of vaccinia virus in the fetuses removed by cesarean section, tissue samples from various organs, as well as from the placenta, the umbilical cord and the amnion, were ground with sterile alundum; and the suspensions, after fortification with antibiotics, were inoculated on the chorioallantoic membranes of embryonated eggs. Blood samples and amniotic fluid were similarly tested.

To substantiate the identification of chorioallantoic membrane lesions as vaccinial, neutralization tests with serum known to be immune were performed. Histologic preparations also were made of these various tissues, including the jaws. The young spontaneously delivered at term were killed at 1, 7, 21, 40 and 60 days of age, as the size of the litter allowed. The mandibles and maxillae were prepared for histological study, and the blood and other tissues were tested for the presence of the vaccinia virus. Similar procedures were carried out on 16 adult female rabbits.

In order to determine the effect of another strain of vaccinia virus on maternal blood and on fetuses *in utero*, 3 pregnant rabbits were inoculated with a neurotesticular strain, a Levaditi testicular strain obtained from the Rockefeller Institute of New York.

To prepare a source of virus for inoculation, the lypholized preparation was suspended in 1.0 cc. of sterile distilled water and inoculated in 0.2 cc. doses into the testes of normal susceptible rabbits. After the development three days later of typical vaccinial orchitis, the macerated testes were suspended in physiological saline solution fortified with antibiotics; and 1.0 cc. doses, of a titer greater than 10^{-5} on embryonated egg membranes, were administered to each animal via the marginal ear vein. Inoculations were made during the first, second and third trimesters respectively. Four to 5 days later, cesarean sections were performed; and the removed fetuses, amniotic fluid and blood of the mothers and of the fetuses were tested for vaccinia. Both whole and lysed blood were cultured.

A final group of 6 pregnant rabbits were inoculated with heavy doses of vaccinia; 4 animals received the dermal lymph strain, and 2 received the neurotesticular strain.

Four additional uninoculated adult female rabbits, normal fetuses at varying stages of development, and delivered young served as controls.

RESULTS

Generalized infection, as evidenced by visceral or lip lesions (Fig. 1), developed in 22 of the first group of 33 inoculated rabbits. Pregnancy was confirmed in 11 of these animals. Two of them died during the operation, 4 completed a successful course of pregnancy with delivery of viable young at term, and 4 others gave evidence of fetal resorption at the time of the cesarean section. Although

there were placental remnants in only 2 of the latter 4 animals, all the uteri gave indications of previous pregnancy.

The eleventh pregnant animal showed no evidence of a normal progression of gestation after removal of 2 fetuses during the first trimester. Since there were no fetuses when the animal was killed 23 days after breeding and since there was no evidence of abortion, it may be assumed that resorption had occurred. Whether this resorption was due to the operative procedure or to the generalized infection is conjectural. The remaining 11 animals that had a generalized infection gave no evidence of pregnancy at any time.

From the group of rabbits that failed to demonstrate unmistakable clinical evidence of generalized vaccinial infection, tests for the presence of circulating neutralizing antibodies were performed on the serums of three rabbits. These tests were positive. The young of another animal likewise demonstrated the presence of neutralizing antibodies.

Five of the 11 rabbits in this group delivered viable litters at term. A sixth animal, from which 2 fetuses had been removed on the twenty-seventh day of gestation, apparently delivered only one nonviable offspring 5 days later. It may be assumed, however, that the remainder of the litter, left undisturbed at the time of the operation, also had been delivered but were eaten by the mother. No evidence of pregnancy was manifested at the operation in the 5 other rabbits comprising this group.

In no instances were vaccinial lesions noted on the fetuses, placentas or fetal membranes of the animals examined at the time of the cesarean section; nor was the vaccinia virus isolated from any fetal specimen—placenta, umbilical cord, amnion, amniotic fluid, heart, lung, liver or fetus *in toto*. Similarly, there were no cutaneous lesions on the newborn, nor was the virus detected in the whole blood, liver, spleen, lungs, adrenals or gonads of the young at the time that they were killed. Two young, 60 and 70 days of age respectively, proved immune to dermal scarification from a virulent suspension of vaccinia. One of these animals was bred when mature and delivered a normal-appearing litter. The blood of one of these second generation offspring failed to show a detectable titer of antibodies neutralizing against vaccinia.

Visceral tissues from the adult inoculated rabbits that died during the operation or were killed within a month after inoculation also were studied for the presence of vaccinia. The earliest such examination was 15 days after inoculation. In no instance was the virus isolated from samples of the uterus, the ovary, the adrenal, the liver, the spleen and the lung. Of the mothers whose blood was examined, only 2 animals showed viremia after inoculation. In one, the virus was isolated on the second day, and in the other it was recovered from the second through the fourth day. All blood samples taken prior to inoculation were negative.

Of the 22 animals with a generalized infection, 16 had lip and nasal lesions. For the purpose of demonstrating the apparent nature of such lesions, the vesicular fluid was cultured from 4 cases. In each instance, vaccinialike pocks were produced on the chorioallantoic membranes of embryonated eggs. As indicated previously, neutralization tests with serum known to be immune were carried out to substantiate the identity of the isolated virus, regardless of the initial source. In all cases it was established that the virus was that of vaccinia.

In view of this evidence of the apparent inability of the dermal lymph strain of vaccinia virus to cross the placenta, it became of interest to determine whether a neurotesticular strain would behave similarly. Three rabbits of 7, 13 and 23 days' gestation, respectively, were inoculated in the marginal ear vein with

1.0 cc. of a virus suspension of a titer greater than 10^{-5}. On the third to fourth day after inoculation, lip lesions appeared in the first two animals, and generalized abdominal cutaneous lesions appeared in the third animal. Circulating neutralizing antibodies in the serum of the latter rabbit were demonstrated 3 days later at moderately high titer. Samples, both lysed and whole blood, of the mother and fetuses, including the amniotic fluid, which were removed from each animal both before and 4 to 5 days after inoculation tested negative for the presence of vaccinia virus.

Since there were only 2 instances of viremia in the first two experimental groups of 36 inoculated rabbits, the possibility was considered that the infection was not severe enough to cause a prolonged blood phase. Furthermore, this relative absence of virus in the circulating blood might have accounted for the apparent failure of transplacental passage. Therefore, 6 additional animals were inoculated with heavy doses of virus.

Four of these after 9, 15, 27 and 28 days' gestation, respectively, were inoculated directly in the abdominal aorta with 4.0 cc. doses of a dermal strain virus suspension, having a titer greater than 10^{-7}. In all instances, blood samples and fetuses were removed prior to inoculation; these served as controls. After inoculation, single fetuses were extracted by cesarean section at intervals up to 5 hours. In the periods between operations, the abdomen was closed with Michel wound clips.

At the same time, blood samples were taken from the heart of the mothers. In order to test for the presence of virus in the fetal tissues and whole blood of the mothers, methods similar to those already described were used. For all samples, including control samples, the findings were negative.

Unfortunately, the operative procedure resulted in the death of 3 animals so that further cesarean sectioning could not be performed. In the surviving rabbit, inoculated at 28 days' gestation, a severe generalized vaccinial infection developed 4 days later. This infection was manifested by extensive dermal lesions on the nose, lips, ears and abdomen. Fetuses removed from this animal at 5 and 24 hours after inoculation were not viable, and testing for vaccinia was not done because of the post-mortem change.

The remaining 2 rabbits in this third group were inoculated with a suspension, of a titer greater than 10^{-6}, of a neurotesticular strain of virus. In both instances, maternal blood and fetuses were removed prior to inoculation in order to provide control samples. The first animal was inoculated with 4.0 cc. via the abdominal route at 16 days' gestation. Three hours later another fetus was removed, and a sample of lysed and whole blood was taken from the mother at the same time. As in the case of the 4 animals inoculated with the dermal strain, these tissues tested negative for vaccinia.

Since the aorta route of inoculation presented certain difficulties, the sixth animal at 22 days' gestation was inoculated directly in the left ventricle of the heart with a like dose. Unfortunately, death occurred 5 minutes later; the cause was undetermined, but the attack resembled anaphylactic shock. No vaccinia virus was recovered from the fetus or whole blood which was removed immediately after death. In this case, however, the lysed blood proved positive when it was cultured on egg membranes.

The over-all results of this study demonstrated that vaccinial infection occurred in inoculated pregnant rabbits but that apparently the virus, in dosages used, was unable to cross the placenta.

Despite the rather common use of the rabbit as an experimental animal, little attention has been given to the subject of the growth and development of its teeth. During the early weeks of life there are 6 maxillary incisors, arranged in 2 parallel rows of 3 teeth each, extending

from the labial aspect to the lingual aspect. At approximately 21 to 30 days of age, the middle incisor in each row is lost as a deciduous tooth; a permanent complement remains, consisting of 2 large labial incisors and 2 small lingual incisors.

A broad expanse of palate separates the germinal ends of these teeth from the 6 posterior teeth on each side of the maxillary arch. During the early weeks of life, this portion of the dentition is comprised of both deciduous and permanent molars; the 3 most anterior teeth on each side are deciduous and are replaced by premolars.

In the mandible, there are 5 posterior teeth on each side of the arch; the first and second molars are deciduous and are succeeded by premolars. The remaining mandibular teeth, including the incisors, have no deciduous predecessors. The germinal ends of the two incisor teeth extend posteriorly and almost contact the mesiolingual aspects of the first premolars. A formula for the permanent dentition may be recorded as $\text{I } \frac{2-2}{1-1}, \text{ P } \frac{3-3}{2-2}, \text{ M } \frac{3-3}{3-3}$.

In contrast to the dentitions of the more commonly used laboratory animals such as the rat and the mouse, all permanent teeth of the rabbit grow continuously throughout life. It is possible, therefore, to make long-term observations of odontogenesis in not only the incisor teeth but the premolars and molars as well. The incisor of the rabbit is quite similar to that of the rat. With the exception of the characteristic longitudinal grooving on the convex surface of the maxillary labial incisor (Fig. 2, left above), the exposed tooth surface appears as a smooth, regular structure.

Histologically also, the rabbit incisor is similar to the rat incisor. The structure of the convex portion of the basal third, which is shown in Figure 2, left below, is typical of the structure of the incisor of all 4 rabbits in the control group. Clearly evident are the well-formed ameloblastic layer, the underlying smooth-surfaced organic enamel matrix and the uniform dentinoenamel junction. The dentin, likewise, is of regular appearance with a well-defined zone of predentin and an intact, well-differentiated, odontoblastic layer.

Unlike the incisors, the premolar and molar teeth have a rather more complex histologic structure and developmental pattern. The interpretations in the few published reports of the rabbit dentition[25, 26] are vague. A brief description of that dentition is of aid in understanding the mechanism of abnormal odontogenesis.

As stated previously, the permanent posterior teeth are similar to the incisors in that they grow continuously throughout life. Figure 2, right above, shows the characteristic deep invagination of inner enamel epithelium and odontoblasts, which extend from the occlusal region to the apex. Distinctly separate pulps and tooth lobes or segments communicate only by virtue of a broad dental papilla at the germinal root end and are bound one to the other by an osteocementoid material.

Figure 2, right below, shows amelogenesis and odontogenesis in the apical region of each segment. A distinct variation in ameloblastic activity on different tooth surfaces accounts for the relative sparsity of enamel in certain regions such as the distal portion of the maxillary teeth.

In contrast to the normal gross and histological appearance of the incisor and posterior teeth of the control rabbits, striking abnormalities were noted in the incisors and posterior teeth of the animals inoculated with vaccinia. Periods

25. Weber, Rud. Vergleichende Anatomie der Molaren von Lepus cuniculus und Cavia cobaya. Deutsche Monatschr. f. Zahnh. 43:245, 1925.

26. Chievaro, Angelo. Experimental researches upon the physiological morphology of the upper posterior small incisors of rabbits. N. D. A. Jnl. 7:829 Oct. 1920.

of observation from the time of the inoculation to the time the rabbits were killed ranged from 35 to 330 days. In all but two instances, distinctive abnormalities were noted.

Hypoplastic lesions in the incisors usually became grossly evident at approximately 160 days after inoculation (Fig. 3). This timing corresponded closely enough with the calculated rate of eruption that in most instances it was possible to anticipate the time when dental defects would appear on the clinical crowns. The linear grooving and pitting of the coronal

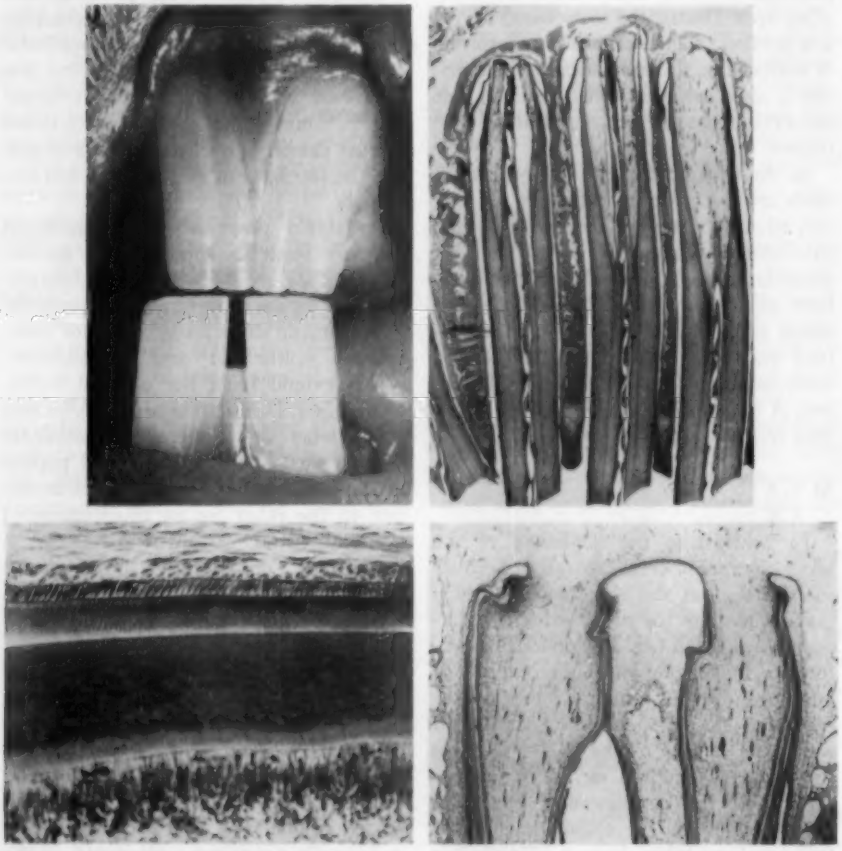

Fig. 2 • Left above: Incisor teeth of control rabbit. Smooth regular surfaces and longitudinal grooving in maxillary incisors are characteristic. Left below: Histologic structure of basal third of control rabbit incisor. Arrangement of ameloblasts, organic enamel matrix, dentin and odontoblasts is uniform. Right above: Maxillary posterior teeth of control rabbit, showing regular arrangement of formative cell layers and normal-appearing enamel and dentin. Right below: Higher magnification of apical region of maxillary molar tooth from control animal, showing active amelogenesis and dentinogenesis. Characteristic invaginations of the formative cell layers in the mid-field create two pseudoroot formations, which because of their extreme apical position are not bound by the osteoid cementing material which is observed in other sections

surfaces shown in the photographs of Figure 3 are characteristic of the incisors of all the rabbits with gross abnormalities.

Although animals killed before the fifth month after inoculation did not show gross evidence of abnormal dental development, roentgenological examination often revealed defects in the unerupted portions of the teeth (Fig. 4, above). Such changes, however, are more strikingly demonstrated in histologic sections.

Figure 4, center left, shows the typical wavelike irregularity which appears as a defect in the gross view. As seen in Figure 4, center right, the enamel space often is obliterated at points of deepest invagination of the inner enamel epithelium. An irregularity extends along the dentinoenamel junction as well as along the pulpal border of dentin. In most instances, the dentin has a prominent striation of dark-staining and light-staining bands, probably denoting intermittent periods of either abnormal matrix formation or hypocalcification (Fig. 4, below left).

Figure 4, below right, a higher magnification of the same incisor, shows the organic enamel matrix underlying the normal-appearing ameloblasts and the gradual disappearance of the enamel as it approaches the depth of the crevice, where formative cells are absent. A more pronounced abnormality of odontogenesis is illustrated in Figure 5, above left. Clearly evident are the enamel spaces at the summits of the wavelike deformities and their obliteration by osteoidlike tissue in the regions of deepest invagination. Figure 5, above right, shows such areas in greater detail. Projecting downward and contacting the dentin are eosin-staining formations containing cellular lacunae and occasional capillary vessels.

In order to determine whether such abnormalities could be attributed to a specific infection of the formative dental tissues, routine Giemsa stains were made of representative sections from a number

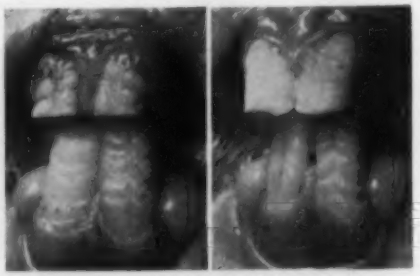

Fig. 3 • Left: Aplasia of enamel of incisor teeth of rabbit 166 days after inoculation with dermal strain of vaccinia virus. Right: Similar defects in incisor teeth of another rabbit 181 days after inoculation with dermal strain of vaccinia virus

of the inoculated animals. In no instance were Guarnieri bodies found. This result contrasted with the consistent observation of such inclusion bodies in sections of lip and nasal lesions.

Changes similar to those noted in the incisor teeth were observed also in the premolars and molars of the rabbits inoculated with vaccinia. Figure 5, below, shows spikelike irregularities extending from the apical to the coronal regions in the maxillary posterior tooth of an inoculated rabbit. As in the case of the incisor abnormalities, these irregularities involve both the enamel and the dentin.

In contrast to the definite changes manifested in the developing dentition of adult animals inoculated with the virus, no abnormalities were noted in the fetuses or delivered young of infected rabbits regardless of the stage of gestation when infection was produced. Similarly, no unusual findings were observed in the young of animals inoculated with vaccinia prior to breeding.

DISCUSSION

The fact that in a number of the rabbits inoculated with vaccinia no clinically demonstrable cutaneous lesions developed does not necessarily indicate an ab-

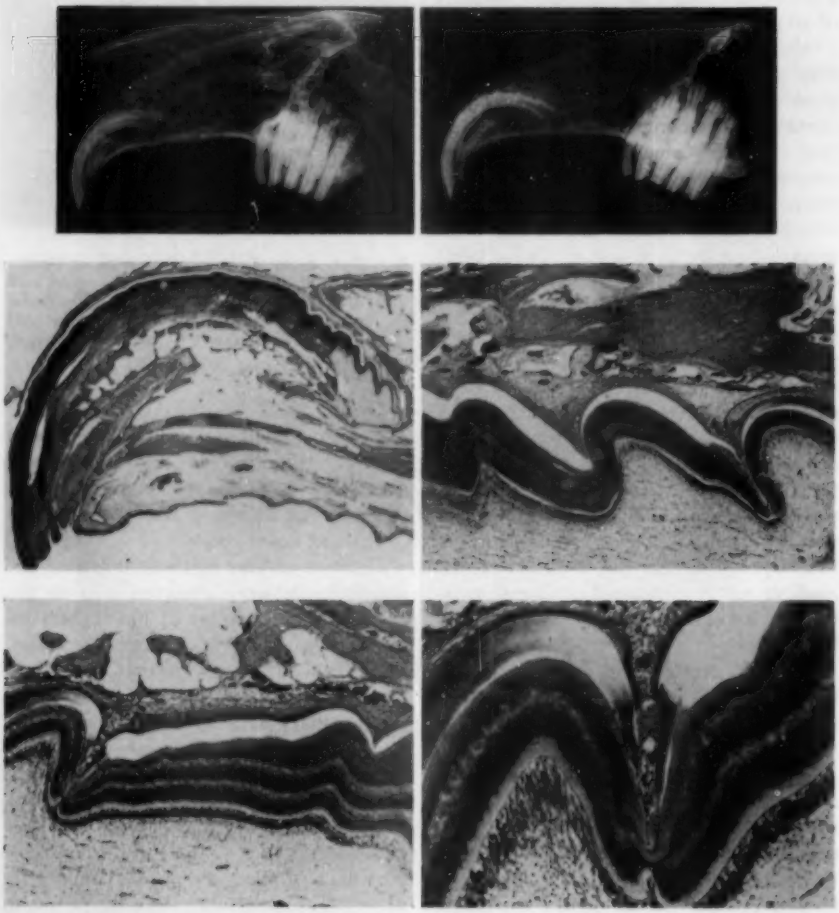

Fig. 4 • Above left: Normal-appearing maxillary incisor, premolar and molar teeth of control rabbit. Above right: Maxilla of rabbit killed 75 days after inoculation with dermal strain of vaccinia virus. Abnormal odontogenesis is apparent in unerupted portions of incisor and posterior teeth. Notch on labial surface near incisor tip was created artificially for the purpose of recording eruption rate. Center left: Wavelike irregularity of enamel and dentin in maxillary incisor from rabbit inoculated with dermal strain of vaccinia virus 181 days before it was killed. Lingual incisor has similar appearance. Center right: Higher magnification of apical third of same incisor, showing notchlike defects of enamel and corresponding irregularity of dentinoenamel junction and pulpal wall. Below left: Abnormality in maxillary incisor of rabbit killed 196 days after inoculation. Dentinal striations are evident. Below right: Higher magnification of prominent defect (left). Uniform organic enamel matrix underlying normal-appearing ameloblasts is present on either side of deep invagination. There are no formative cells in depth of crevice, and osteoidlike material contains large lacunae and vascular elements

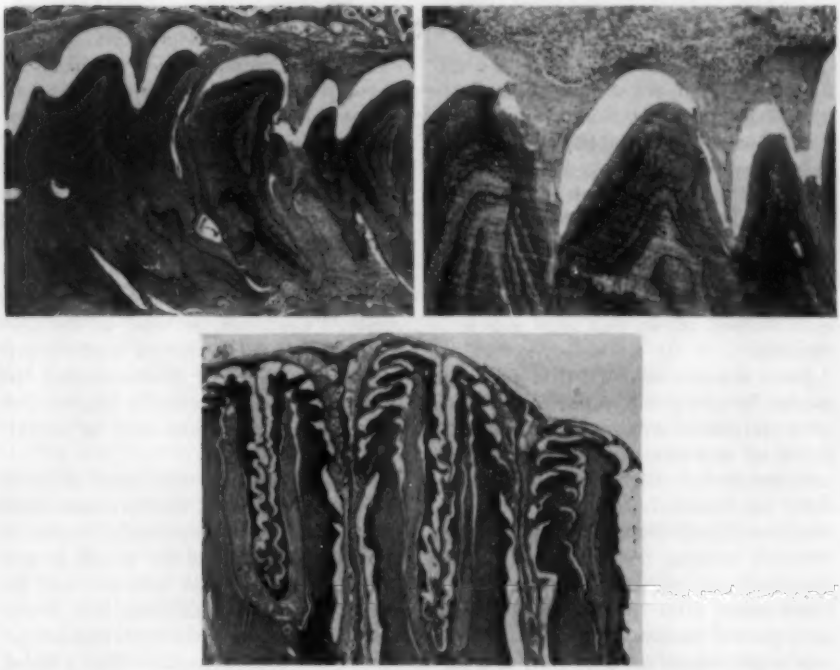

Fig. 5 • Above left: Defects in incisor of rabbit killed 330 days after inoculation with vaccinia virus. Enamel spaces overlie dark-staining, prominently striated dentin. Above right: Higher magnification of same tooth, showing osteoidlike material projecting into depths of notchlike defects where they contact dentin. Enamel spaces occur between regions of invagination. Below: Enamel and dentin abnormalities in maxillary posterior teeth of rabbit inoculated with dermal strain of vaccinia virus 330 days before it was killed. Comparison of corresponding areas in this figure and Figure 2, right above, shows decided contrast

sence of infection. The severity of the disease and the extent of the lesions may be influenced significantly by such factors as the strain of the virus, the amount of inoculum, and the age and the strain of the experimental animal.[14] Furthermore, the possible extent and frequency of visceral lesions in the absence of cutaneous lesions were not ascertained in many cases because of prolonged intervals between the inoculation and the time the animal was killed.

Circulating neutralizing antibodies were confirmatory evidence of the initiation of vaccinial infection in inoculated rabbits. Although the possibility was considered that the presence of these antibodies might represent a serologic cross immunity, no evidence of disease other than vaccinia was observed at any time. Moreover, vaccinial antibodies were not demonstrated in a series of serologic controls. Consequently, any grouping of experimental animals in the present study on the basis of clinical symptoms indicating degree of infection would be arbitrary.

Viremia could not be used as an indication of generalized infection, since in only 2 instances was the virus observed in washed cell suspensions, although mucosal and cutaneous lesions frequently

developed in regions distant from the site of inoculation.

In view of the possibility that a different result might be obtained from blood samples other than washed cells, namely whole and lysed blood, additional animals were studied. As indicated previously, the whole blood of 4 rabbits inoculated with rather heavy doses of a dermal strain of vaccinia failed to show a viremia. Current preliminary studies of lysed blood from similarly inoculated animals showed results that were extremely variable.

Since it was considered that a viremia might be observed more consistently after infection with a neurotesticular strain of vaccinia, 6 additional rabbits were inoculated with both light and heavy doses of Levaditi's strain. In tests of whole and lysed blood at postinoculation intervals ranging from 5 minutes to 5 days, only one culture, a sample of lysed blood tested after an interval of 5 minutes, proved positive. These varied findings might suggest the possibility of a previously established immunity; in no instance, however, had any of the experimental animals been exposed before inoculation to rabbits infected with vaccinia. Therefore, despite the infrequent demonstration of viremia, it may be assumed, on the basis of the experimental evidence, that infection was established.

As stated previously, 16 of the 33 rabbits in the first experimental group showed no evidence of pregnancy. In 7 of these cases, exploratory laparotomies performed during the period of expected gestation failed to provide evidence that conception had occurred. Although no such direct observations were made of the other 9 animals, it may be assumed either that they did not conceive or that the course of the pregnancy was interrupted.

The question of the influence of the time of the inoculation on the course of gestation in the 17 pregnant animals is of some interest in view of the 5 instances of fetal resorption. Seemingly significant was the fact that these animals had been inoculated either prior to or within ten days after breeding. Since more than half of the rabbits that completed a normal course of pregnancy were inoculated at similar periods, however, the relationship of the resorption to the inoculation with the virus in the first trimester is questionable.

Severe vaccinial infection has been reported as causing an interruption of pregnancy.[14] Certainly, in view of the fact that in the present study a variable susceptiblity of animals to inoculation has been demonstrated, a similar explanation for the fetal resorptions may be considered possible.

Since no evidence was found of infection in the fetuses of mothers inoculated with dermal or neurotesticular strains of vaccinia, regardless of the period of gestation when maternal infection was induced, it may be assumed that transplacental passage of the virus did not occur. It has been postulated that a break in the placental barrier is a prerequisite for fetal vaccinial infection. The relatively few published reports of this occurrence therefore may be explained on the basis of specific placental injury. This hypothesis is in agreement with the assumption of Goodpasture[27,28] that chorionic epithelium in the hemochorial type of placenta is a naturally resistant medium to such viruses as variola, varicella and vaccinia.

Of further significance in this regard are the observations of Greenberg and others[29] concerning mass vaccinations during the smallpox outbreak of 1947 in New York City. In a study of over 4,000

27. Goodpasture, E. W., and Anderson, K. Virus infection of human fetal membranes grafted on chorioallantois of chick embryos. Am. J. Path. 18:563 July 1942.

28. Goodpasture, E. W. Virus infection of the mammalian fetus. Science 95:391 April 17, 1942.

29. Greenberg, M., and others. The effect of smallpox vaccination during pregnancy on the incidence of congenital malformations. Pediatrics 3:456 April 1949.

infants of mothers vaccinated during the early months of pregnancy, these workers found that the occurrence of congenital defects and stillborn offspring was no greater than that in a comparable number of babies born of nonvaccinated mothers. It would be of interest to investigate this question further by subjecting pregnant rabbits to progressively more severe vaccinial infection.

It may be assumed that the dental abnormalities which were observed in the inoculated adult rabbits are attributable to the vaccinial disease, in spite of the fact that Guarnieri bodies were not observed in the developing teeth or in their supporting structures. It is of interest to note that in selecting rabbits for this study occasional instances of gross dental hypoplasias were observed. Without exception the animals with such hypoplasias showed definite signs or had a previous history of chronic upper respiratory infection. Such rabbits were not included in the present study.

The characteristic appearance of the dental abnormalities as well as preliminary observations of eruption rates in the experimental and control groups suggests that the disturbance initiating the defects was one of retarded eruption rather than of specific localized infection. Until this possibility is confirmed, the pathogenesis of developmental dental disturbances in rabbits infected with vaccinia cannot be established.

Of particular interest in the present study is the fact that no developmental dental abnormalities were observed in the fetuses or delivered young of mothers infected with vaccinia regardless of the stage of pregnancy when they were inoculated. Although this negative finding is consistent with the apparent absence of transplacental infection, it should be noted that the maternal dental abnormalities, probably related to altered eruption rates, may have been due to certain metabolic dysfunctions incident to the disease rather than to the infection itself. If this is the case, the question arises as to why embryonic dental development was not influenced by similar factors, especially in light of previous reports attributing fetal dental defects to various maternal metabolic disturbances.[30-32] It is obvious that a wide variety of maternal disturbances undoubtedly have no demonstrable influence whatever on the developing fetus.

SUMMARY AND CONCLUSIONS

The specific relationship of congenital abnormalities to rubella and other virus diseases occurring during pregnancy has been the subject of considerable speculation, particularly with regard to the question as to whether such defects are the result of transplacental infection or systemic dysfunctions incident to the maternal disease.

Although only rubella has received widespread attention, it is conceivable that other virus diseases of the mother may have similar effects on fetal development. Inasmuch as dental defects are among the fetal abnormalities attributed to rubella in the mother, the study of odontogenesis provides a method to determine the response of the fetus to such adverse maternal influences.

Since the more common laboratory animals of choice are not susceptible to rubella, the virus of vaccinia was used in this experiment. Forty-two adult female rabbits were inoculated intravenously with dermal lymph or neurotesticular strains of vaccinia virus at varying periods before and after breeding with males of known fertility. The following observations were made:

30. Kreshover, S. J.; Clough, O. W., and Bear, D. M. Prenatal influences on tooth development. I. Alloxan diabetes in rats. J. D. Res. 32:246 April 1953.

31. Kreshover, S. J., and Clough, O. W. Prenatal influences on tooth development. II. Artificially induced fever in rats. J. D. Res. 32:565 Aug. 1953.

32. Mellanby, Helen. The effect of maternal dietary deficiency of vitamin-A on dental tissues in rats. J. D. Res. 20:489 Oct. 1941.

1. Vaccinial infection was confirmed by (1) the appearance of mucosal and cutaneous lesions, (2) the isolation of the virus by inoculation of vesicular fluid on the chorioallantoic membranes of embryonated eggs and (3) the demonstration of circulating neutralizing antibodies.

2. The demonstration of viremia was infrequent and inconsistent, regardless of the strain of virus used, dosages administered or methods of study of blood.

3. No evidence was found of transplacental infection, regardless of the strain of virus used, dosages administered or the period of gestation when infection was induced in the mother.

4. Striking gross and microscopic dental defects occurred in the developing incisor, premolar and molar teeth of adult rabbits inoculated with vaccinia.

5. No dental abnormalities were noted in the fetuses or delivered young of mothers infected with vaccinia, regardless of the strain of virus used or the stage of gestation when the mother was inoculated.

6. No maternal or fetal dental abnormalities were observed in the control group of animals.

Denture base materials and the refitting of dentures

S. Howard Payne, D.D.S., Buffalo

A succession of denture base materials were developed rapidly one after another during the thirties. Today, however, the most commonly used are copolymers of acrylic resin. From the standpoint of ease of processing, lightness, cleanliness and appearance they have won almost universal acceptance. One of the disadvantages in their use, however, is the shrinkage which takes place during processing. The search for a similar material which will not be affected dimensionally by processing, still goes on. Laminated fiber glass was tried. At the present time, work is being done with styrene which has good dimensional stability.

Acrylic resins of today are available in jells or in powder and liquid form. Both types are processed by heating. Many methods have been advocated for this curing procedure. In work at the University of Buffalo School of Dentistry, the curing apparatus is kept at 162°F. at all times, and students process their cases for nine hours at this temperature. This is done merely as a matter of convenience so that students can put their flasks in the curing unit at any time without worrying about the temperature.

One of the best ways to effect complete polymerization is to bench cure the

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cases for a half hour after packing, then begin the processing in cold water. The temperature is brought up to 165°F. for two hours and then the flask is allowed to boil for 30 minutes. After cooling back to room temperature, the flasks are opened.

In the past two years, activated, or so-called cold-cured, resins, have come on the market. By means of catalytic heat producers, the material is polymerized without heating in water. Because the net temperature rise is lower in the case of these activated resins, there is less dimensional change than with the heat-cured resins. For repairs, temporary linings, and even for temporary appliances, the self-cured resins have proved a boon to dentistry. At the present time, however, they are not color-stable and are more expensive than the heat-cured resins if used in full denture work.

SERVICING OF DENTURES

Periodic and careful servicing of dentures is important, but patients often neglect this aspect of dental care. In a sense, it is a compliment to dentistry that patients expect dentures to have unlimited life, even though they change automobiles, clothes, tires, and other items of normal living every few years or even months. It is true, of course, that some people have very little bone change, and consequently very little settling of the denture. On the other hand, in people who lose their teeth from periodontal disease or who have some systemic disorder such as diabetes, anemia, avitaminosis, or poor dietary habits, rapid resorption is apt to occur. These people need constant and careful attention to keep their dentures in adjustment, as these changes are caused by settling. Immediate dentures also need considerable attention during the first few months.

Refitting of Dentures • Refitting of dentures is one of the most difficult and exacting procedures in prosthetic dentistry. It is a procedure which generally is done in a hurry because few people want to wait longer than absolutely necessary to get back their dentures. Many times, when the refitted dentures are inserted in the mouth, it is found that the upper one does not fit particularly well, the bite may be open, and the original occlusal relationship no longer present.

When intercusping teeth are used, slight settling may produce excessive movement of the bases. Cusped teeth which are not interdigitated, nonanatomic teeth, or an occlusal scheme with a zero incisal guidance will adapt more readily to a certain amount of change without introducing excess trauma to the ridges. To accommodate these changes, two materials are available which are useful under varying conditions. The soft plasticized resins are easily placed in the immediate denture and will continue to flow for two or three hours. The patient has no burning sensation with these materials, but they become foul after a few months in the mouth. More of this resin can be substituted for the deteriorated material as the tissues change further, until the immediate denture is ready to be refitted in a more stable substance.

For those individuals who need their dentures refitted, but who do not have the necessary time to accomplish this in the usual manner, the self-cured resins are valuable, but must be handled extremely carefully. They harden very quickly, as many dentists have found to their sorrow. This characteristic, coupled with a severe smarting sensation which the patient experiences when the resin is introduced into the mouth, make these resins difficult to manage. These self-cured resins can be used more successfully in the refitting of free saddle partial dentures, or sections of a denture where the area is not so great and the material can flow readily.

There are many methods of refitting dentures, of course, and each dentist has his own particular favorite; however,

space does not permit the enumeration of all of the methods. One of the most important precautions that must be observed is to have the patient leave his dentures out of the mouth (but in water) for about 24 hours preceding the taking of new impressions. This allows traumatized, inflamed or displaced tissue to regain its more normal form. Almost every dentist has had the experience of having a patient's dentures settle and push their way into the tissue, and after being rebased, not seem to fit properly even though all steps have been done with extreme care.

The first step is to place the rebased dentures in the mouth and examine the occlusion carefully so as to estimate the amount of change that has taken place. The height and extent of the peripheral borders must be checked so as to be sure that they are neither overextended nor short. When necessary, the periphery should be shortened, and, of course, all undercuts in the dentures should be removed. On the upper denture, a low fusing compound is used and a new periphery is traced. The patient sucks and swallows as this periphery is added. It will require the utmost care to keep the upper denture from moving forward too much as this periphery is added; each time the denture is seated, it should be placed upward and backward.

When the periphery has been satisfactorily re-established, a new posterior palatal seal or postdam should be added. This too, should be flamed, tempered and tried in the mouth several times to make sure that it is not displacing too much tissue. At this time the denture should exhibit positive peripheral seal. The patient's upper lip should be lifted to see if the denture is adequately sealed from cuspid to cuspid. This is one of the most common sites for mistakes to occur.

At the University of Buffalo School of Dentistry, it has been found that in taking the secondary impression of the upper denture, a plasterlike material is preferable to one of the pastes or to any other material. A hole about the size of a no. 8 rose bur is drilled through the center of the palate, and a thin mix of the plasterlike material is placed in the palate and worked around inside the denture. The denture is carried to the mouth, seated upward and backward, and the patient is instructed to close the teeth lightly to check the occlusion. When set, the upper denture is removed carefully and the impression checked. If the vault area of the denture shows through, it means that relief is required, and the wash must be removed, the center of the palate trimmed down, and the wash redone. This usually is not necessary, however, as the added periphery and the postdam will relieve the palate sufficiently.

If the impression is acceptable, neither too thick nor too thin, the denture is placed back in the mouth, and the operator is ready to proceed with the lower denture. Here again, the periphery must be checked carefully; usually it is not necessary to shorten it. Undercuts in the labial portion of the ridge can be removed, but the distal lingual areas of the lower denture are sometimes easier to manage if they are trimmed off entirely at the time the lower denture is half-flasked. This can be done by using a sandpaper disk which, when run at high speed, will literally burn its way through the acrylic resin. Any other undercut areas that cannot be removed at the time of the impression can be treated in like manner.

On the lower denture, then, at the time the impression is taken, a new periphery is traced, either of low fusing compound or a soft wax, and the patient goes through normal tongue movements so as to establish the peripheral extent. For the lower dentures, zinc oxide and eugenol pastes are extremely useful. The paste is placed on the lingual aspect first; then the denture is inserted in the mouth, and the patient goes through tongue movements to check the periphery, then closes

the teeth lightly so as to check occlusion. The lower denture is removed, the lingual aspect is checked, and then paste is added around the entire periphery. The denture is reinserted in the mouth, and tongue movements and muscle movements are again executed. At this time the occlusion is checked. When the paste is added to the lingual aspect first, it tends to prevent the forward movement of the lower denture which would result in a thick labial and buccal periphery and a thin lingual aspect which would be sharp and would not afford a normal amount of retention.

The dentures are now boxed in the same manner as conventional impressions and carefully poured with a dense mix of stone. After setting, the boxing material and all excess plaster and other materials are trimmed until the denture on the cast is clean. A sandpaper disk is used to remove the entire palate of the upper denture and the impression material underneath. A new palate, one sheet of baseplate wax thick, is now waxed in and smoothed up to the borders. Undercut areas on the lingual or labial aspects of the lower denture can be cut through with the sandpaper disk until the undercut portion is free from the denture itself. This portion need not be removed, however, but the cut merely filled in with wax.

The dentures are now half-flasked, painted with a 3/8 inch matrix of stone and full-flasked with plaster. On removal, all impression material is cleaned from the inside of the denture, and the wax flushed out with boiling water. A coarse trimmer is used on the periphery of the denture to cut to the stone, and the inside of the periphery is cut to the fresh acrylic resin. The casts are checked, the upper postdam is scraped if necessary, and the casts scrubbed. The old acrylic resin is now painted with monomer and packed with new resin.

Rebased dentures should be cured for about five hours at 160°F. and then cooled back to room temperature. Under no circumstances should they be boiled, as this would cause a difference in the dimensional change of the old resin and the new and would result in a poor fit.

The dentures are recovered from the flask, polished, and reinserted into the mouth. At this time the patient is instructed to bite as hard as he can for two or three minutes in order to seat the dentures adequately. A plaster syringe is used to squirt plaster on the occlusal surfaces so that a check-bite can be taken. The patient should close the teeth lightly so that they do not bite all the way through. When set, the dentures are removed and mounted on an adaptable articulator. At this point, spot grinding and milling are necessary to re-establish occlusal relationships and provide for possible unlocking of the occlusion. In order to obtain the best possible occlusion, the face-bow should be used and check-bites should be taken. If this technic is used, the patient will have a set of dentures which are a satisfaction both to him and to the dentist.

Duplication of Dentures • If dentures are to be duplicated, the impressions are taken in the same manner as for refitting. The casts are poured. Each denture then should be mounted separately on an articulator and a remount record taken. The occlusal surfaces of the posterior teeth should barely penetrate the plaster remount record; anteriorly the incisal edges may go in approximately 2 mm. It is a good precaution after this plaster remount record has set, to make a plaster core for the labial surfaces of the anterior teeth. The articulator used for the remount records should have an anterior guide pin. With the guide pin set firmly, the denture can be removed from the cast and the teeth flamed out if they are porcelain or cut out of the old acrylic resin. The teeth are now placed back in the remount record, and the labial surfaces are checked with the matrix. A soft wax

rim is now laid around the diatoric and pin surfaces of the teeth as they are situated in the remount record. The wax is allowed to cool and tie all the teeth together. The teeth should be checked to be sure that they have not moved from their positions in the record. The articulator is now closed, and the cast and wax rim are attached with more wax. This is allowed to cool and then, very carefully, the articulator is opened, at which time the teeth will come out of the remount record and maintain their correct relationship to the cast. The denture can now be waxed up. It should be checked again in the remount record, however, before flasking.

COMMENT

There are many methods of duplicating dentures, all of which have certain advantages. Most of them take less time than the method described, but should something happen, the denture is a complete loss and has to be remade. One method, which works well, however, and which is used at the University of Buffalo School of Dentistry, is to take a conventional impression for a rebase, but care is taken to insure that the undercuts are removed. A cast is poured and the boxing material removed. Old teeth then are replaced, wax is added around the necks of teeth, if necessary, and corrections are made wherever indicated before the denture is half-flasked. A 3/8 inch matrix of stone is painted over the denture before full-flasking. The flask halves are separated and the upper half of the flask that contains the denture and teeth is placed upright in a burnout oven which is gradually brought up to about 400 or 500 degrees. The old resin will sizzle and burn and finally soften and can be removed with two pairs of tweezers. It must be removed carefully so as to avoid the danger of breaking teeth. Teeth which come out of the stone with the softened denture material can be removed and reglued back in the flask. Twenty minutes in the furnace usually is a sufficient time to soften the resin. After the flask has cooled, the cast is prepared in the same manner as for the other rebase, and the denture is packed.

This is a quick and easy method of duplicating a denture, although it requires slightly more time for polishing; it takes less time to make the records, however. Rebases or duplications can, of course, be done with self-cured resins as well as with the heat-cured resins, and less dimensional change probably will result. When packing these self-cured resins, there is not sufficient time for a number of trial flask closures. After they are packed, however, they can remain in the bench press and are ready for removal in a half hour or so, and can be polished immediately.

SUMMARY

The refitting of dentures can be done best with heat-cured acrylic resins. Although many cold-cured relining resins are available that can be used directly in the mouth, it has been found that consistently good results are not obtained by the average operator if the cold-cured resins are used. These resins can be used to advantage for the filling in of small saddle areas, for additions to the periphery of the denture, for the repairing of fractures or broken teeth, or for making temporary appliances. If used for an entire denture, better results are obtained by flasking the denture and packing under pressure. It is more satisfactory to duplicate the denture rather than to reline the old one. Each step in the process must be checked carefully in order to insure good results.

Cases and Comments

STOMATITIS CAUSED BY GONOCOCCUS

By A. A. Copping, D.D.S., New Orleans.

A well-developed, well-nourished white man, age 21, reported February 26, 1952, with generalized soreness and dryness of the mouth, burning sensation beneath the lips, much difficulty in eating solid food and in opening and closing the mouth. He also had a sore at the opening of the penis.

The patient's past history revealed that he had never had any infections of the mouth; however, he had had acute gonococcal urethritis one year previous. Family history was noncontributory.

Oral clinical examination revealed that the oral mucosa was fire red with numerous areas of greenish yellow patches, from which came a yellow exudate. The patient's lips were chafed and bled readily. There was an abundance of thick, ropy saliva and a slight soreness of the throat. There was no evidence of periodontal disease or salivary gland infection. The patient experienced extreme pain from any type of movement of the oral cavity.

The following were ordered: smears and cultures of the lesions of the oral cavity, darkfield illumination of the oral cavity and genito-urinary consultation. The smears showed gram-negative intracellular and extracellular diplococci predominating. Gram-positive diplococci also were present. The cultures revealed organism of the Neisseria group, *Streptococcus hemolyticus* and hemophilus type of organisms. These smears and cultures were repeated several times with the same results.

The genito-urinary consultation report stated that there had been urethral discharge and burning on urination for the past four days, acute gonococcal urethritis one year previously, no other urinary complaints. Examination revealed that the external genitalia were normal except for the external urethral meatus, which appeared occluded and covered with dried blood. Spreading of the meatal lips was painful and showed inflamed mucosa at the orifice. It was concluded that there probably was etiological connection between the oral and urethral lesions.

Gram stain urethral smears showed rare pus cells, many epithelial cells, rare gram-positive diplococci and large gram-negative bacilli. The urinalysis showed the urine to be a clear straw color, reaction alkaline, specific gravity 1.031, albumin negative, sugar negative, few squamous epithelial cells.

Penicillin (300,000 units) was given immediately with 100,000 units of penicillin administered every four hours. Warm saline mouth rinses every hour for ten minutes were prescribed. The patient was placed on a liquid diet.

On the third day healing began to take place, with new epithelium being produced over the eroded areas. On the fifth day there was no evidence of pathological disturbance, and healing took place without scar tissue. All lesions disappeared in five days under penicillin therapy.

4704 Paris Avenue

The opinions or assertions contained in this article are the private ones of the writer and are not to be construed as official or reflecting the views of the Navy Department or the naval service at large.

APHTHOUS STOMATITIS

By Morris M. Blum, D.D.S., Brooklyn.

A white man, age 40, had had routine dental examinations twice annually for over 15 years. Operative restorations were made when required. The degree of caries has been average. There has been no alveolar or soft tissue disease other than a chronic condition, diagnosed as aphthous stomatitis. This condition has been present continuously, with intervals of relief of only six or seven days. At times, the extent of involvement, the discomfort and pain made intake of food impossible, even by tube.

Medical examinations and laboratory tests indicated the patient was normal physically. So far as he can remember his general health has been good, except for occasional gastric discomfort.

Salivation has been somewhat excessive. Recent laboratory examinations, barium tests and roentgenograms disclosed a duodenal ulcer. The patient was placed on the usual ulcer diet of milk and cream. Methantheline bromide (Banthine) was the medication prescribed.

In the six month period since the start of the medication, there has been a noticeable reduction in salivary flow and a complete absence of aphthous ulcers. A single case proves nothing, yet further investigation is warranted. The indication is that salivary flow may be related to the formation of aphthous ulcers.

55-20 Myrtle Avenue

FRACTURED TEETH

By Martin T. Siegel, D.D.S.,
Poughkeepsie, N. Y.

A young woman, aged 24, came for a routine dental checkup. A full-mouth roentgenogram was taken which indicated that the maxillary central and lateral incisors on the left side were fractured (illustration). The patient recalled having accidentally fallen eight years previously, at which time the crowns were fractured and "dangled from the gingiva." The patient stated that she had reinserted the crowns and did not go to a dentist for treatment; in fact, this was her first visit to one since that time. She said that she had experienced no pain or discomfort during the intervening period.

Clinically, the teeth were slightly discolored, just a shade darker than the rest. Testing of the pulp indicated a vitality of plus ten; the adjoining normal teeth registered plus six. There was a small amount of vitality remaining in the injured teeth. The crowns were as secure as were those of the adjoining teeth which had not been fractured.

This case is interesting for the following reasons:

1. The crowns were secure, being held in position chiefly by the gingiva; palpation and percussion indicated that these crowns were as secure as were those of the normal teeth.
2. The roentgenogram revealed no periapical infection.
3. There was no history of pain or discomfort during the eight years succeeding the fracture.
4. Their presence was contrary to what one might expect.
5. There was still vitality remaining in the injured teeth.

Such a case emphasizes the fact that treatment of traumatic injuries of this type should be conservative.

27 Cannon Street

Fractured maxillary central and lateral incisors

ALGINATE IMPRESSIONS AS AN AID IN OCCLUSAL EQUILIBRATION

By Frank M. Kyes, D.D.S., Norfolk, Va.

An important corrective measure in the treatment of periodontal disturbances and temporomandibular joint disorders is the grinding of teeth that occlude prematurely. In determining which high points or fossae should be ground to distribute loads or to harmonize occlusion in centric relation, wax bites, articulating paper and mounted study casts usually have been used. The use of horseshoe-shaped interocclusal alginate impressions furnishes a simpler and more accurate method of determining the surfaces to be ground.

The patient is taught to close his jaws in centric relation to the point where he makes the first light contact between the upper and lower teeth. When he has learned to do this, a small mix of alginate is made. A cement spatula is used as a carrier. A cigarette size roll of alginate is placed over the occlusal and incisal surfaces of the lower teeth. The patient closes his teeth gently into the alginate until he feels the first light tooth contact. This position is maintained until the alginate sets.

The patient then opens his mouth, the alginate is loosened from the lower teeth, and the patient pushes the registration forward with his tongue. The check-bite is dropped into a plaster bowl partly filled with water. The check-bite is studied carefully, and grinding is then undertaken according to accepted principles.

The illustration shows a registration in water in a dark bowl. The perforations indicate points of contact, and the darkened areas indicate near contact. Contact surfaces seen from the mandibular side of the check-bite will, in general, appear on the maxillary side as being in fossae instead of on cusps or on cusps instead of in fossae.

Thus a study of the perforations made when the teeth are in centric relation and a study of the eccentric positions of the jaw would furnish the clue as to whether to grind cusp or fossa. This registration is used for correcting centric occlusion only and is of no value

Alginate check-bite seen from its mandibular side.

for making corrections in the working and balancing positions.

As a patient closes his teeth into the alginate, the teeth meet no resistance. When wax is used, there is a tendency for the mandible to move slightly lingually or laterally.

In addition, the alginate material results in sharper detail and thus gives a clearer picture than either wax, which allows the teeth to shift, or articulating paper, which smears.

Making an alginate check-bite is much faster than mounting study casts and conveys as much or more information in contacts and near contacts when the teeth are in centric relation. Hence, the check-bite can supplant mounted study casts as well.

The opaque alginate registration can be "read" easily as it lies in the plaster bowl. The fact that the check-bite shows thin areas as well as perforations allows the operator to anticipate future contacts and to perform more grinding with one registration. He can grind some surfaces more heavily than others and does not have to stop so often to evaluate his work.

Alginate impression material is an excellent substitute for wax bites, articulating paper and mounted study casts as a diagnostic tool in equilibrating centric occlusion. The horseshoe-shaped interocclusal registrations possess many advantages over previously recommended methods.

Alginate interocclusal records appear to be the best method yet devised to determine premature contact in centric preliminary to selective grinding for equilibration.

Although no effort has been made to enlarge on the uses of the check-bite for other purposes, it is obvious that the check-bite would be valuable in checking the occlusion of complete dentures, provided the dentures were stable. Also, if used immeddiately, they provide an accurate means of occluding study models and certain types of partial denture models, prior to mounting the casts on an articulator.

The opinions or assertions contained in this article are the private ones of the writer and are not to be construed as official or reflecting the views of the Navy Department or the naval service at large.

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MALOCCLUSION AND SPEECH DEFECTS

By Howard E. Kessler, D.D.S., Cleveland.

Individuals with malocclusion are more apt to have a speech defect than individuals who have normal occlusion. On this assumption arises an interesting question; namely, at what point does the malocclusion actually determine whether or not a speech defect will be present?

A long range study of the problem of the exact relationship of malocclusion to speech defects has been in process since 1949. At the completion of this study it is hoped that there will be answers to the following questions: Why do many individuals with severe malocclusion have perfect speech? Can a speech defect cause malocclusion, such as a speech defect in which pressure of the tongue may push the upper anterior teeth into protrusion? Does the height of the palatal vault or the width of the upper arch have anything to do with whether or not a child lisps? Does the amount of the open bite determine whether or not a child has difficulty with his sibilant sounds?

Twin girls, 9 years of age, have been studied in an attempt to answer some of these questions. One child is 45⅛ inches in height, 45 lbs. in weight, with a probable learning rate of 97 and an open bite of 2 mm. The second child is 45 inches in height, 46½ lbs. in weight, with a probable learning rate of 93 and an open bite of 4.5 mm. The child with the 4.5 mm. open bite has difficulty with sibilant sounds while the child with the 2 mm. opening has no difficulty.

Here are twins with the same home and school environment, who eat the same foods, who get the same amount of sleep and who have the same living habits. They are practically the same in every respect except that the child with the largest bite opening has a speech defect. In neither case are the ante-

rior teeth fully erupted. Is it possible that the 2½ mm. difference in the open bite is the difference between their having or not having normal speech?

Dentofacial speech consultant, Cleveland school system, Cleveland Board of Education; member, board of trustees, Cleveland hearing and speech center, Western Reserve University.

A COMFORTABLE CRANIAL SPLINT FOR CERVICAL TRACTION

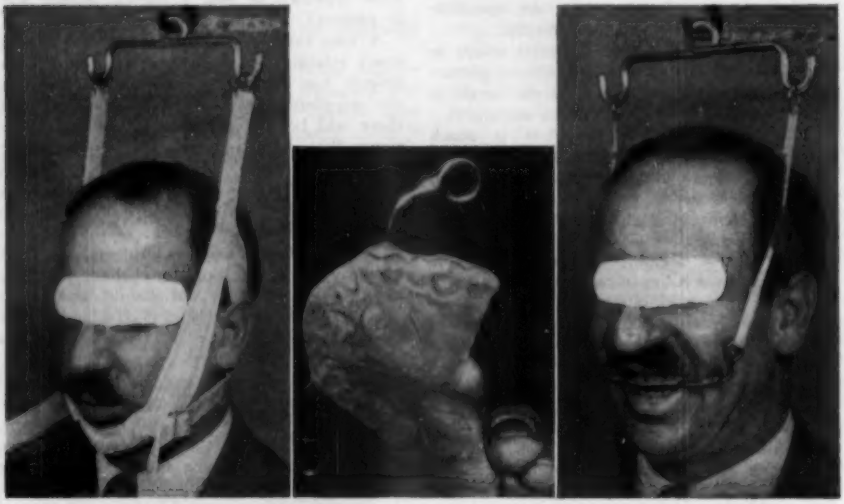
By W. Ward Tracy, D.D.S., New York.

The conventional cloth head halter type of splint (illustration, left) that encases the mandible is effective for obtaining cervical traction, but as most of the pressure is applied to the temporomandibular joint, it is painful.

A maxillary splint can be constructed rapidly and inexpensively, using a stone model made from a colloid impression of the maxillary teeth. The denturelike splint, with the buccolabial portion eliminated, is made of acrylic resin (illustration, center). A stiff wire or cast metal arm with rings in the end is processed in the splint. These arms protrude from approximately the first bicuspid region. They should be located back as far as possible but not far enough to stretch the corners of the mouth.

The harness is constructed from three pieces of cloth tape (illustration, right). The wide tape that passes behind the head is approximately 1 inch wide and 15 inches long and is joined to the other two narrower ten inch tapes above and in front of the ear. The maxillary splint, because it relieves the pressure on the temporomandibular joint, eliminates the pain associated with the conventional cloth head halter splint.

9 Rockefeller Plaza



Left: Conventional splint and head halter. Center: Denturelike splint of acrylic resin with rings. Right: Completed splint and head halter

BUREAU OF ECONOMIC RESEARCH AND STATISTICS

Survey of former Armed Forces dental officers

This survey was undertaken to obtain information which would help in solving the difficult problem of staffing the Armed Forces dental corps. What can be done to make careers in the Army, Navy and Air Force more attractive to dentists? With a larger roster of career dental officers, fewer temporary officers would be required. The necessity of replacing temporary dental officers has been and continues to be a major problem, sometimes appearing almost insoluble. A related question is whether the present ratio of approximately two dentists per thousand military personnel is justified. Information from dentists who have completed tours of duty can be helpful in answering this question and many others. Information from this survey pertains particularly to the work of the Council on Federal Dental Services, which is charged with evaluating the efficiency of dentistry in the Armed Forces.

In June 1954, questionnaires were sent to 3,250 dentists who had been discharged from the Armed Forces since January 1950. The questionnaire, a four-page folder, was designed in consultation with members of the Central Office staff and with dentists in military advisory and consultative positions, particularly the Council on Federal Dental Services.

Questionnaires received up to August 6 are included in this statistical analysis. By that date, 1,477 questionnaires had been received, representing about 45 per cent of the original mailing list. This is an excellent return for a mail survey. There is a possibility, however, that the nonrespondents would have furnished facts and opinions different from those included in this analysis. Signature was optional and about three out of every five questionnaires were signed.

No question was answered by all respondents. In questions of fact, the "no answers" were eliminated so that totals would be 100 per cent. In questions of opinion, answers were of course optional and those who did not answer were included in the base for computation of percentages. In general, factual questions will be dealt with first in this analysis as they provide background for better understanding of the opinion questions.

Forty per cent of the questionnaires were from dentists who had served with the Army, 26 per cent with the Navy and 34 per cent with the Air Force.

Of all respondents, 74.4 per cent indicated they had been in private practice immediately prior to entry into service. Twenty per cent reported they were students immediately preceding their period of service, but this figure was only 10.4 per cent in the Navy compared with about 24 per cent in both the Army and the Air Force. This difference may be explained by the fact that 21.3 per cent of the Army and Air Force dentists indicated they had entered service under an Armed Forces senior dental student program, compared to only 5.7 per cent of Navy dentists.

The age distribution of survey respondents is shown in Table 1. There were 83.4 per cent under 35 years of age

Table 1 • Percentage distribution of respondents by age

Age	Army	Navy	Air Force
25-29	16.7	23.9	15.0
30-34	57.3	59.5	64.3
35-39	16.5	13.4	14.7
40-44	4.2	2.6	3.5
45-49	3.0	.3	1.3
50-54	1.5	.3	1.0
55-	.8	.0	.2
Total	100.0	100.0	100.0

in the Navy, compared to 79.3 per cent in the Air Force and only 74.0 per cent in the Army. More of the respondents graduated in 1947 than any other year (23.0 per cent), and only 3.5 per cent had graduated prior to 1943.

Table 2 shows the percentage distribution of respondents according to year of entry into and release from military service. The majority of dentists participating in this survey entered service in 1951 (57.1 per cent). Most of the discharges (68.8 per cent) occurred in 1953. (Length of service for dentists registered under Public Law 779 is 24, 21, 18 or 15 months, depending on amount of prior service.) Eighty-seven per cent of the respondents returned to practice in the states in which they had resided before entering service.

The percentage of respondents who were registered under Public Law 779 (physicians' and dentists' draft act) at the time of entry into service varied from 38.0 per cent for Navy dentists to 63.7 per cent for Air Force and 67.5 per cent for Army dentists. The other large category consisted of dentists who were reservists when Public Law 779 was passed and were therefore not required to register. This group had liability for service equivalent to that of special registrants. Only about 3 per cent of the respondents had entered service as members of the regular Army, Navy or Air Force.

Table 2 • Percentage distribution of respondents by year of entry into and year of release from military service

Year	Entered military service	Released from military service
1941-1948	1.3	.0
1949	2.4	.0
1950	22.7	.3
1951	57.1	.4
1952	11.0	23.6
1953	5.5	68.8
1954	.0	6.9
Total	100.0	100.0

At the time of the survey, 39.3 per cent of the dentists who had served in the Army held dental reserve commissions, compared to 62.5 per cent of the Navy dentists and 60.6 per cent of the Air Force dentists.

Table 3 • Percentage distribution of dental officers by rank at time of entry into military service

Rank		Army	Navy	Air Force
0-1	2nd Lt., Ensign	5.7	1.3	6.5
0-2	1st Lt., Lt. (j.g.)	54.0	73.7	59.1
0-3	Capt., Lt.	36.9	23.5	32.2
0-4	Maj., Lt. Comdr.	1.9	1.0	2.0
0-5	Lt. Col., Comdr.	1.5	.5	.2
	Total	100.0	100.0	100.0

The average rank of dentists entering the Navy was lower than that of dentists entering the Army or Air Force (Table 3). The majority of dentists entered in grade 0-2 in all three branches. Most if not all of those dentists who entered in grade 0-1 entered through the senior dental student program. Percentages of dentists promoted from grades 0-2 and 0-3 are shown in Table 4. In the Air Force, 62.3 per cent of the dentists were promoted during their tour of duty, compared to 40.1 per cent in the Navy and 38.6 per cent in the Army.

To the question, "Were you ever eligible for a promotion which was delayed or never given?" a "yes" answer was given by 37.7 per cent of the Army dentists, 22.7 per cent of the Air Force

Table 4 • Percentage of dental officers promoted to specified rank, for dentists who entered in grades 0-2 and 0-3

Rank at time of entry	Rank at time of release	Army	Navy	Air Force
0-2 1st Lt., Lt. (j.g.)	1st. Lt., Lt. (j.g.)	43.0	51.2	11.8
	Capt., Lt.	55.4	47.0	85.7
	Maj., Lt. Comdr.	1.2	1.4	2.5
	Lt. Col., Comdr.	.4	.4	.0
	Total	100.0	100.0	100.0
0-3 Capt., Lt.	Capt., Lt.	96.0	87.8	89.9
	Maj., Lt. Comdr.	3.4	12.2	10.1
	Lt. Col., Comdr.	.6	.0	.0
	Total	100.0	100.0	100.0

dentists, and 14.4 per cent of the Navy dentists. Approximately half of these dentists in each branch indicated they had not been informed as to the reason for delay in promotion.

Four out of five dentists who had served with the Air Force reported they received no basic training (Table 5). The Navy was characterized by a high percentage reporting only one or two weeks of basic training, and longest basic training periods were reported by dentists from the Army. The largest percentage of respondents who thought the length of their basic training period was "about right" was among those who had had only one or two weeks (Table 6). Among those whose basic training lasted three to four weeks, there was about an even split between the "too long" and "too short" answers; the great majority of dentists who had longer periods of basic training indicated these periods were "too long."

As shown in Table 7, the average tour of duty of respondents was about two years. A small number of the respondents had been on duty since World War II. These were offset by the special registrants who were not required to serve the full 24 months. Fifty-seven per cent of the respondents had served exactly 24 months. Table 7 gives the average number of months of overseas duty among all respondents, including those with no time overseas. Among those who did serve overseas, the averages were as follows: Army, 16.1 months; Navy, 10.4 months, and Air Force, 15.8 months. Percentages of respondents who served overseas were as follows: Army, 48.9 per cent; Navy, 38.6 per cent, and Air Force, 31.3 per cent.

The question, "Were your assignments generally in line with your dental training and experience?" was answered "yes" by 88.0 per cent of the Army dentists,

Table 5 • Percentage distribution of respondents by number of weeks of basic training received

No. of weeks	Army	Navy	Air Force
0	49.4	45.1	81.8
1-2	.9	39.7	.3
3-4	11.7	9.2	10.1
5-6	24.2	2.2	6.8
7-20	13.8	3.8	1.0
Total	100.0	100.0	100.0

Table 6 • Percentage distribution of respondents by opinion of length of basic training period, according to number of weeks of basic training

Opinion	Number of weeks basic training				
	0	1-2	3-4	5-6	7-20
Too long	.0	7.2	12.3	22.0	38.5
Too short	13.2	14.5	14.1	7.7	4.4
About right	24.0	75.7	66.2	67.6	53.8
No opinion	62.8	2.6	7.4	2.7	3.3
Total	100.0	100.0	100.0	100.0	100.0

Table 7 • Mean number of months of service as a dental officer, domestic and overseas

Location	Army	Navy	Air Force
In the United States	16.4	18.4	19.0
Outside the United States	7.9	4.0	5.0
Total	24.3	22.4	24.0

Table 8 • Percentage of dentists commenting as indicated in connection with the question: "If you were performing general dentistry, were you given the opportunity to practice in the full scope of general dentistry?"

Comment	Army	Navy	Air Force
Fillings only—amalgam line—operative dentistry only	18.8	20.3	9.2
No (or too little) prosthetic work	10.3	22.1	6.2
No (or too little) crown and bridge work	1.9	5.7	1.5

Table 9 • Percentage distribution of replies to the question: "In your opinion, how does the productivity (amount of work done per day) of the average dentist in military service compare with that of the average civilian dentist?"

Reply	Army	Navy	Air Force
Lower (in military service)	20.4	20.3	21.5
Slightly lower	6.5	8.2	6.1
Much lower	13.2	23.4	20.5
25% to 50% lower	12.1	19.2	11.8
Total, lower in service	52.2	71.1	59.9
About the same	21.0	12.7	16.1
About the same per hour	.7	3.0	.7
Respondent speaking for self—did as much in service	1.3	1.1	1.3
Total, same in service	23.0	16.8	18.1
Higher in service	11.9	4.8	10.0
Much higher in service	2.4	.0	1.5
Respondent speaking for self—did more in service	1.1	1.1	1.8
Total, higher in service	15.4	5.9	13.3
Varied with individual or with post or station	9.4	6.2	8.7
Total	100.0	100.0	100.0

90.0 per cent of the Navy dentists, and 93.0 per cent of the Air Force dentists. A related question, "Were you satisfied with your assignments?" received "yes" answers as follows: Army, 76.3; Navy, 83.5, and Air Force, 82.6. There are, of course, many possible reasons for dissatisfaction with an assignment other than having an assignment not in line with training and experience.

To the question, "If you were performing general dentistry, were you given the opportunity to practice in the full scope of general dentistry?" a "yes" answer was given by 42.7 per cent of the Army dentists, 33.7 per cent of the Navy dentists, and 63.8 per cent of the Air Force dentists. The respondent was invited to comment regarding this aspect of his service and these comments are presented in Table 8. The most common complaint was that the dentist was on the "amalgam line," with little or no opportunity to provide services other than fillings. This complaint was less prevalent among dentists from the Air Force than among dentists from the other two branches.

Table 10 • Percentage distribution of replies to the question: "In general, what is your opinion regarding the number of dentists assigned to the units in which you served?"

Reply	Army	Navy	Air Force
Understaffed	35.9	36.1	34.5
Overstaffed	14.1	14.3	19.3
Neither understaffed nor overstaffed	40.4	41.5	36.3
Varied from post to post	9.6	8.1	9.9
Total	100.0	100.0	100.0

The majority of respondents thought the productivity of the average dentist in service was lower than that of the average civilian dentist (Table 9). This opinion was held by 71.1 per cent of the Navy dentists, 59.9 per cent of the Air Force dentists, and 52.2 per cent of the Army dentists. Nevertheless, more than twice as many dentists thought the units in which they served were understaffed as thought they were overstaffed with dentists (Table 10). A plurality of respondents checked "neither understaffed nor overstaffed."

Table 11 • Percentage distribution of respondents according to percentage of duty time devoted to treatment of military personnel

Per cent of time	Army		Navy		Air Force	
	Overseas	Domestic	Overseas	Domestic	Overseas	Domestic
100	11.7	11.2	14.2	28.4	4.0	3.3
95-99	11.2	18.3	17.2	23.8	17.1	18.0
90-94	9.0	16.9	12.7	16.7	18.7	20.5
80-89	16.6	16.0	20.1	11.2	19.5	21.0
70-79	13.5	11.4	14.2	8.2	13.0	13.7
60-69	14.8	5.2	6.0	3.0	14.6	9.6
50-59	10.3	6.4	8.2	1.9	3.3	4.3
25-49	8.0	3.6	3.7	2.2	3.3	2.8
1-24	3.1	2.4	1.5	.8	4.9	1.8
0	1.8	8.6	2.2	3.8	1.6	5.0
Total	100.0	100.0	100.0	100.0	100.0	100.0

Table 12 • Percentage distribution of respondents according to percentage of duty time devoted to treatment of dependents of military personnel

Per cent of time	Army		Navy		Air Force	
	Overseas	Domestic	Overseas	Domestic	Overseas	Domestic
100	.0	.0	.0	.0	.0	.3
75-99	1.4	.7	.0	.0	2.4	.3
50-74	2.2	3.6	.8	.3	4.0	.7
35-49	6.3	2.4	.0	.3	3.3	2.3
25-34	4.1	4.1	.0	.6	7.3	4.8
13-24	12.2	13.9	.8	3.0	11.4	17.8
8-12	13.1	17.0	3.7	3.8	22.0	28.7
3-7	13.6	18.5	5.3	5.2	16.3	22.0
1-2	4.1	14.1	10.6	12.6	7.3	11.7
0	43.0	25.7	78.8	74.2	26.0	11.4
Total	100.0	100.0	100.0	100.0	100.0	100.0

Table 13 • Percentage distribution of respondents according to percentage of duty time devoted to dental administrative duties

Per cent of time	Army		Navy		Air Force	
	Overseas	Domestic	Overseas	Domestic	Overseas	Domestic
100	.4	.0	.0	.0	.8	.5
75-99	.4	.5	.0	.5	.0	.3
50-74	1.4	.2	.8	.5	.0	.3
35-49	.0	1.0	.0	.3	1.6	.5
25-34	3.2	1.9	2.3	.8	3.3	.7
13-24	4.1	3.1	6.8	2.8	9.0	4.1
8-12	17.1	8.4	18.9	9.9	13.0	11.7
3-7	22.5	9.4	21.2	19.8	18.7	19.3
1-2	6.8	6.7	10.6	9.9	13.8	10.7
0	44.1	68.8	39.4	55.5	39.8	51.9
Total	100.0	100.0	100.0	100.0	100.0	100.0

To the question, "Were you ever assigned daily or weekly quotas of production to meet in your professional duties?" an affirmative answer was given by 21.6 per cent of Army dentists, 11.3 per cent of Navy dentists, and 14.4 per cent of Air Force dentists. In addition, 5 to 6 per cent in each branch stated that quotas were assigned implicitly rather than explicitly.

The percentage distributions of respondents according to per cent of duty

time spent in various activities are shown in Tables 11 through 14. Dentists who spent less than three months overseas were eliminated from the "overseas" column; likewise, those who spent less than three months in the United States were eliminated from the "domestic" column. The Air Force had the lowest percentage of men who spent all of their duty time treating military personnel. Dentists of the Navy spent a larger proportion of their duty time treating military personnel than dentists of the other two branches. In the Navy, considerably less time was spent in the treatment of dependents. This is borne out by Table 15, which indicates that amalgam and silicate fillings were provided to dependents of military personnel "frequently" by 58.2 per cent of Army dentists and 55.2 per cent of Air Force dentists but only 8.3 per cent of Navy dentists. Other types of services, too, were provided to dependents less often by Navy dentists.

Table 14 • Percentage distribution of respondents according to percentage of duty time devoted to military (nondental) administrative duties

Per cent of time	Army		Navy		Air Force	
	Overseas	Domestic	Overseas	Domestic	Overseas	Domestic
100	.0	.0	.0	.0	.0	.0
75-99	.0	.0	.0	.3	.0	.0
50-74	.5	1.0	.0	.3	.0	.0
35-49	.9	.2	1.5	.0	.0	.0
25-34	2.3	.2	3.8	.0	.0	.0
13-24	4.5	2.6	9.8	2.4	1.6	1.0
8-12	9.0	4.8	10.5	7.4	4.1	3.3
3-7	19.9	9.2	18.0	13.2	10.6	9.9
1-2	8.1	7.2	13.5	9.6	7.3	9.4
0	54.8	74.8	42.9	66.8	76.4	76.4
Total	100.0	100.0	100.0	100.0	100.0	100.0

Table 15 • Percentage distribution of respondents according to replies to the question: "If you provided dental service to dependents of military personnel, please indicate approximate relative frequency with which you provided services in the following categories"

Branch and frequency	Type of service provided to dependents					
	Amalgam and silicate fillings	Inlays, crowns and bridges	Dentures	Oral surgery	Periodontal treatment	Orthodontic treatment
Army						
Frequently	58.2	3.0	8.0	39.2	10.1	.4
Occasionally	17.9	30.8	27.2	37.1	37.6	4.4
Never	3.4	40.7	38.4	4.9	26.6	66.7
No answer	20.5	25.5	26.4	18.8	25.7	28.5
Total	100.0	100.0	100.0	100.0	100.0	100.0
Navy						
Frequently	8.3	.0	.0	7.8	1.8	.0
Occasionally	13.0	4.2	5.0	22.1	11.5	.8
Never	14.9	28.1	28.1	10.4	20.8	31.0
No answer	63.8	67.7	66.9	59.7	65.9	68.2
Total	100.0	100.0	100.0	100.0	100.0	100.0
Air Force						
Frequently	55.2	2.7	5.7	56.5	12.4	3.0
Occasionally	32.6	30.1	30.3	34.3	38.8	5.2
Never	3.5	50.0	46.3	.5	31.6	73.9
No answer	8.7	17.2	17.7	8.7	17.2	17.9
Total	100.0	100.0	100.0	100.0	100.0	100.0

Table 16 • Percentage of survey respondents replying as indicated to the question: "If the time available during basic training was too short for rendering needed dental services, what suggestions do you have for improving this situation?"

Reply	Army	Navy	Air Force
Retain men at training camp until dental work is completed—have special unit for personnel needing extensive treatment	10.3	14.3	8.5
Dental work should be taken care of before induction—dental standards for induction should be raised	8.9	14.1	9.7
Increase facilities and/or personnel at basic training centers	10.3	11.7	7.0
Only the more serious or emergency conditions should be treated in basic training—other dental services can be postponed—not possible to take care of backlog during basic training	7.8	6.0	11.2
More time off for dental care should be allowed while personnel are in basic training	6.5	9.1	4.2
Government should have dental work performed by civilian dentists before induction—there should be a plan similar to the Veterans Administration dental program	6.5	4.7	6.2

Dentists who provided dental care to dependents of military personnel were asked whether it was their opinion that civilian dentists were available to provide this care. Among those who replied, 55.7 per cent of the Army dentists said civilian dentists were available, compared to 62.7 per cent of the Navy dentists and 71.0 per cent of the Air Force dentists.

Respondents were asked whether it was their experience that military personnel in the period of basic training were not given sufficient time for the required number of dental appointments. Approximately two thirds of the dentists from each branch answered "yes." Suggestions for improving this situation were

Table 17 • Percentage of respondents commenting as indicated on the "system of dental record-keeping"

Comment	Army	Navy	Air Force
Excellent	5.3	10.9	25.6
Good	41.8	42.4	45.5
Fair	7.6	4.9	2.5
Poor	6.3	3.9	3.5
Too complicated or too much paper work	14.4	13.6	8.9
There should be a uniform system of records for all services	5.3	.8	2.5
Poor tooth-numbering system	.8	1.3	2.2

Table 18 • Percentage of respondents commenting as indicated on the "adequacy of supplies and equipment"

Comment	Army	Navy	Air Force
Excellent	9.5	16.7	8.2
Good	40.1	40.6	39.1
Fair	6.8	5.2	8.5
Poor	6.3	2.9	12.2
Varied from post to post	3.2	3.4	2.5
Too much "red tape" in getting supplies	8.0	2.1	11.2
Supplies and equipment obsolete or of poor quality	6.8	6.0	9.5
Adequate in U. S. but not overseas	2.7	.0	4.7
There was over-supply and waste	1.7	2.9	2.2
There was under-supply or occasional shortage	3.0	1.0	2.0

Table 19 • Percentage of respondents commenting as indicated on the "arrangement of facilities"

Comment	Army	Navy	Air Force
Excellent	7.6	13.0	9.0
Good	51.9	49.2	45.8
Fair	5.5	4.9	10.4
Poor	4.9	2.9	9.0
Private office should be provided for each dentist	3.2	.5	6.7

Table 21 • Percentage of respondents commenting as indicated on the "efficiency of the dental laboratory set-up"

Comment	Army	Navy	Air Force
Excellent	8.6	7.0	11.4
Good	33.3	33.1	26.6
Fair	11.4	7.3	13.2
Poor	11.0	8.6	18.2
Varied from post to post	4.4	2.3	3.7
Need higher caliber or better trained men	5.3	3.4	8.7

solicited, with the results shown in Table 16.

Dentists participating in this survey were asked to comment on seven aspects of dentistry in the branch of the Armed Forces in which they served. Responses are given in Tables 17 through 23. The usual type of response to these questions was a rating expressed in a single word, such as "poor," "excellent," or "adequate." In the tables, the word "excellent" includes equivalent words such as "perfect," "fine," and so forth; likewise, other words listed include equivalent words. If a respondent offered a specific comment in addition to a one-word rating, both replies were included in the percentages shown in the tables.

A special table has been prepared for the purpose of summarizing the ratings of the seven aspects of military dentistry (Table 24). An average was calculated for each aspect of military dentistry in each branch by setting "excellent" equal to 4, "good" equal to 3, "fair" equal to 2, and "poor" equal to 1. Table 24 permits comparison not only between branches but among the seven phases of military dentistry. These figures should be regarded as approximate rather than precise.

"Quality of dental services provided" received a higher score than any other aspect of military dentistry. "System of record keeping" also ranked high, particularly in the Air Force. "Availability, utilization and training of auxiliary personnel" was rated low, especially in the Army. "Competence of dental administrators" and "efficiency of dental laboratory set-up" also were scored relatively low.

The most common specific comment on the system of record-keeping was that it was too complicated or involved too

Table 20 • Percentage of respondents commenting as indicated on the "availability, utilization and training of auxiliary personnel"

Comment	Army	Navy	Air Force
Excellent	2.7	10.2	5.0
Good	17.5	35.4	28.9
Fair	11.2	7.0	12.4
Poor	21.5	8.1	15.9
Varied from post to post	3.4	4.4	4.0
Shortage of auxiliary personnel—shortage of well-trained personnel	11.0	3.4	8.9
Auxiliary personnel poorly trained, lazy or inefficient	8.4	4.2	9.7
Too many transfers of auxiliary personnel	4.2	1.0	4.2

Table 22 • Percentage of respondents commenting as indicated on "quality of dental services provided"

Comment	Army	Navy	Air Force
Excellent	19.5	20.6	23.6
Good	32.7	39.1	35.8
Fair	5.3	2.6	6.7
Poor	4.6	1.0	3.0
Varied from post to post	10.5	3.1	7.5
Varied with the individual dentist	15.2	9.4	13.4
Better quality than civilian dentistry	1.5	5.7	3.0
Operative dentistry good, prosthetics and surgery poor	3.0	2.3	1.2

Table 23 • Percentage of respondents commenting as indicated on "competence of dental administrators"

Comment	Army	Navy	Air Force
Excellent	8.6	8.1	11.9
Good	21.1	23.7	21.1
Fair	7.4	6.8	12.2
Poor	14.3	9.9	15.4
Varied from post to post	13.7	17.7	13.2
Stressed military aspects of service too much, professional aspects too little	7.8	4.9	6.5
Too concerned with quotas, monthly reports, work sheets	3.4	2.1	2.5

much paper work. This comment was made by 14.4 per cent of the Army dentists, 13.6 per cent of the Navy dentists, and 8.9 per cent of the Air Force dentists. Regarding adequacy of supplies and equipment, "red tape" in procurement was mentioned more often than anything else by Army and Air Force dentists but not by Navy dentists. Few dentists offered a specific comment regarding arrangement of facilities, but most of those who did stated a private office should be provided for each dentist. A shortage of auxiliary personnel, or of well-trained auxiliary personnel, was mentioned by 11.0 per cent of the Army dentists, 3.4 per cent of the Navy dentists, and 8.9 per cent of the Air Force dentists.

The relatively few comments on the dental laboratory set-up centered mainly on the need for higher caliber or better trained laboratory technicians. The most common complaint regarding competence of dental administrators was that they stressed military aspects of the service too much and professional aspects too little.

As shown in Table 25, respondents were asked to indicate ways in which military dentistry could be made more attractive to dentists and to record any inequities they may have observed in service. Some respondents made as many as five distinct comments in reply to this question; all such replies are included in Table 25.

The most frequent reply to this question was "allow the dentist to do all types of dental work—eliminate the amalgam line," which was mentioned by 26.2 per cent of the Army dentists, 24.0 per cent of the Navy dentists, and 17.9 per cent of the Air Force dentists. Of equal importance to Air Force dentists was "separate the dental department from the medical department—provide autonomy for the dental corps." The second-ranking suggestion was to provide higher pay for dental officers. The suggestion that the individual dentists be given more independence, responsibility and freedom in treatment planning was given by 14.4 per cent of the Air Force dentists, 10.8 per cent of the Army dentists, and 6.5 per cent of the Navy dentists. The 25 suggestions made most often are listed in Table 25.

The final question solicited suggestions as to how the American Dental Association or its affiliated societies could render better service to its members serving in the Armed Forces (Table 26). This question was not answered by a large proportion of respondents. The most common entry was that the respondent had no such suggestions to offer. The suggestion made most often was that the Association

Table 24 • Average ratings* on seven aspects of dentistry in the Armed Forces

Aspect of military dentistry	Army	Navy	Air Force
System of dental record-keeping	2.8	3.0	3.2
Adequacy of supplies and equipment	2.8	3.1	2.6
Arrangement of facilities	2.9	3.0	2.7
Availability, utilization and training of auxiliary personnel	2.0	2.8	2.4
Efficiency of dental laboratory set-up	2.6	2.7	2.4
Quality of dental services provided	3.1	3.3	3.2
Competence of dental administrators	2.5	2.6	2.5

*Averages were obtained by applying the following scale to data in Tables 17-23: Excellent = 4, good = 3, fair = 2, and poor = 1.

Table 25 • Percentage of respondents replying as indicated to the question: "Please indicate ways in which you believe military service can be made more attractive to dental officers. What inequities, if any, did you observe?"

Reply	Army	Navy	Air Force
Allow dentist to do all types of dental work—eliminate amalgam line	26.2	24.0	17.9
Provide higher pay for dental officers	11.8	11.7	17.7
Allow individual dentist more freedom in treatment planning—dentist should be given feeling of independence and responsibility	10.8	6.5	14.4
Have better housing and assignments for married personnel—allow dentist to choose location—station dentist close to home	8.9	12.0	11.2
There is a need for more competent, higher caliber, regular dental officers, administrators or base dental officers	11.6	6.0	9.7
Eliminate discrimination against reserve officer	11.5	7.0	7.7
Separate dental department from medical department—provide autonomy for the dental corps	5.3	3.1	17.9
Promotions should be based on experience, age or length of service—promotions should be automatic	9.1	7.3	5.5
Require higher ranking officers (or administrative officers, or regular officers) to do more clinical work	5.7	7.6	6.2
Service dentists should be sent to conventions—short courses should be provided	7.4	4.4	7.7
Eliminate (or deemphasize) rank among dentists and physicians—eliminate insignia of rank	4.2	2.1	7.2
Less emphasis should be placed on military aspects of service, more on professional	4.0	5.2	3.2
Promotions should be based on ability (rather than on age or length of service)	3.8	3.4	4.5
More respect should be shown for the dental profession	2.7	4.4	3.7
Statement of approval of Armed Forces as they are	4.2	2.9	5.2
Eliminate the uncertainties of military life	4.0	5.2	3.2
Provide higher rank for dental officers—provide more rapid advancement	3.2	3.6	3.5
Eliminate production quotas	3.4	1.3	3.8
Emphasize quality more, quantity less	3.8	1.3	2.7
Do not use dentists as administrators	2.3	1.0	2.7
Equalize rank of dentists with physicians	2.5	.3	5.0
Armed Forces should fulfill promises regarding promotions	5.3	.5	1.0
Have similar promotion policies in all branches of the services	2.5	5.7	.0
Eliminate excessive moving around—have fewer transfers	1.3	2.1	3.5
Eliminate dental care for dependents of servicemen	1.5	.8	5.0

Table 26 • Percentage of respondents replying as indicated to the question: "Do you have any suggestions as to how the American Dental Association and its constituent and component societies can render better service to its members who are serving in the Armed Forces?"

Reply	Army	Navy	Air Force
Statement that respondent had no suggestions to offer	5.5	9.6	9.0
Make sure that anyone physically able to practice dentistry as a civilian is liable for military service—induct men who have never served—require older men to serve (rather that having younger men serve twice)	6.3	10.4	5.7
The Association or constituent or component societies should investigate bases at which dentists complain of inequities—there should be a grievance committee to which the military dentist can complain	9.7	3.9	6.5
Take action to separate the dental department from the medical department	4.9	1.3	11.7
See that the dental officer is allowed to do all types of dental work	6.1	6.3	4.0
A committee of the Association should pass on policies or programs proposed by the Armed Forces—the Association should serve in an advisory capacity	4.9	5.7	7.5
The Association should correspond with and provide information and materials to servicemen—keep closer contact	7.8	3.9	3.7
Commendatory remark about the Association	4.4	4.7	2.7
Make sure that dentists are given ranks commensurate with their professional experience or ability	3.6	3.1	4.2
Have dental care for dependents eliminated or sharply curtailed	2.3	1.3	6.0
Make sure that promotions are given when due—make promotions automatic	3.0	2.9	2.0

should make sure that anyone physically able to practice dentistry as a civilian is liable for military service and that men who have never served should be inducted. Other frequent suggestions were that the Association hear and investigate complaints of dental officers, take action to separate the dental from the medical department, and see that the dental officer is allowed to do all types of dental work.

The Bureau intends to send questionnaires periodically to dentists recently discharged from the Armed Forces. Results of this continuing survey will be reported from time to time in THE JOURNAL.

B. Duane Moen, Director

COUNCIL ON DENTAL HEALTH
COUNCIL ON DENTAL EDUCATION
BUREAU OF ECONOMIC RESEARCH AND STATISTICS

Status of dental personnel in the United States (1954)

The prevailing level of dental health in the various sections of the country is dependent, in large measure, on the number and distribution of dentists and auxiliary personnel. There are other factors that influence the state of oral health, but none has a more direct bearing on the level of dental health care than has the availability of dental personnel. Because of its importance to national as well as community health, dental manpower is receiving an increasing amount of attention among health and education authorities.

A sound evaluation of the number of dental personnel required cannot be founded solely on the principle that dental care should be available to all persons who are in need of such care. The nature and size of the dental disease problem, the attitudes and habits of the people and the ability and willingness to pay for dental care also have an important bearing on dental personnel needs.

EXTENT OF DENTAL NEEDS

Dental health needs comprise all the oral conditions that require the personal services of dentists and their auxiliary personnel. The total dental health needs of the people have not been measured accurately because optimum oral health never has been defined. Estimates have been made, however, of the prevalence of defects for which the dental profession provides preventive and corrective services. These defects include dental caries, malocclusion and other anomalies and deformities, traumatic injuries, periodontal diseases and other oral pathoses.[1-3]

The number of dental defects existing at a given time add up to a total of huge proportions. The prevailing need remains at a high level because of the large number of new defects that occur each year. For example, it is estimated that if all children in the United States between 6 and 18 years of age were given the fillings necessary to restore their mouths to healthy condition, dentists would have to insert 280,000,000 fillings. An additional 38,000,00 fillings would be required every year to repair new cavities. Adults would need 425,000,000 fillings to restore their mouths to healthy condition and, in addition, 100,000,000 fillings a year for maintenance. These figures present the problem only in terms of fillings.[4] Irreparable teeth in the mouths of adults resulted in 48,000,000 extractions performed by dentists in 1950. Replacement of these extracted teeth resulted in the placing of 11,500,000 prosthetic appliances in the same year.[5] These figures do not include the number of extractions and

1. What can be done to improve dental health. In America's health, a report to the nation. New York, Harper & Bros., 1949, p. 277-296.

2. Dollar, M. L., and Kulstad, Hugo. The economic aspects of the dental heath problem. In Dentistry in public health, Pelton, W. J., and Wisan, J. M. Philadelphia, W. B. Saunders Co., 1949, p. 24-44.

3. Public Health Economics, School of Public Health, University of Michigan. Committee reports of the Institute of Dental Health Economics, June 26-July 1, 1944. Unpublished.

4. School of Public Health, University of Michigan. Committee reports of the Institute of Dental Health Economics, June 26-July 1, 1944. (Estimates from these reports revised according to size of population in 1950.)

5. Moen, B. Duane. The 1950 survey of the dental profession. Chicago, American Dental Association, Bureau of Economic Research and Statistics, 1951.

replacements that would be required to put the mouths of adults in healthy condition. To these staggering figures for estimated initial and maintenance care must be added examinations, diagnoses, prophylaxes and periodontal, orthodontic, surgical and root canal treatments. At present, there is a sufficient number of dentists to take care of only a small portion of this large volume of dental need.

Although a reduction of the size of the problem through research and prevention is the final goal, corrective and reparative services, performed by dentists with the assistance of auxiliary personnel, will be needed for many years to come. The extent to which these services are distributed depends, in a large measure, on the public's demand for dental care.

DEMAND FOR DENTAL CARE

Although nearly all persons over three years of age need periodic dental treatment, only a relatively small percentage receive complete care. Some persons obtain only part of the dental service they need, and some receive none or only emergency treatment. The Bureau of Economic Research and Statistics estimated that 42 per cent of the population saw a dentist in 1952.[6] The proportion seeing the dentist and the adequacy of treatment sought and received vary according to such factors as geographic location, income and appreciation of dental health.

Total Need • It would be chimerical to assume that a sufficient number of dentists and auxiliary personnel could be trained to make complete dental care available to all persons in this country even if all of them wanted such care. Strusser[7] estimated that about 160,000 dentists would be needed to correct the dental defects that occur each year and that about 440,000 would be needed to take care of the accumulated needs. Klein[8] estimated that at least 130,000 dentists would be needed for annual maintenance care for the entire population and that 325,000 dentists would be needed if the backlog of dental needs were to be resolved in one year. Other investigators[9] have suggested that there should be 153,000 in 1960 to provide dental care for the civilian population.

Potential and Effective Demand • In a comprehensive study of dental personnel requirements, it is necessary to consider both potential demand and effective demand for dental care.

By potential demand is meant the amount of dental care the people would want if it were readily available and if they were willing and able to purchase it. Effective demand is the amount of dental treatment which the public wants and for which it can pay.

A satisfactory method for determining potential demand has not been found. It is likely, however, that much of the potential demand can be changed to effective demand through better and more extensive dental health education.

The present effective demand as a proportion of total needs for dental care cannot be determined from available data. Rough estimates have been made by using as a guide the total expenditures for dental care. It has been estimated, for example, that the total effective demand for dental care in 1941 was only about a tenth of the total need for dental service.[10] There are no reliable data on

6. Moen, B. Duane. The 1953 survey of dental practice. Chicago, American Dental Association, Bureau of Economic Research and Statistics, 1954.

7. Strusser, Harry. Dental needs and dental manpower. New York D. J. 14:25 Jan. 1948.

8. Klein, Henry. Dental needs versus dental manpower. J.A.D.A. 31:263 Feb. 1944.

9 Dewhurst, J. Frederick, and associates. America's needs and resources. New York, Twentieth Century Fund, 1947, p. 226.

10. Dollar, M. L. Need and demands. J.A.D.A. 38:559 April 1949.

Table 1 • Examples of fluctuations of national income as compared with expenditures for dental care, 1929-1953*

Year	National Income	Expenditure for dental care
1929	$ 87,814,000,000	$ 482,000,000
1935 (depression year)	57,057,000,000	302,000,000
1940	81,634,000,000	419,000,000
1945	181,248,000,000	648,000,000
1949	216,193,000,000	931,000,000
1950	239,956,000,000	959,000,000
1952	290,959,000,000	1,028,000,000
1953	305,002,000,000	

*Survey of Current Business, U. S. Department of Commerce, July 1953, July 1954, and 1951 National Income Supplement.

Note: In contrast to the Department of Commerce estimate of slightly over one billion dollars spent for dental care in 1952, a survey of the incomes of dentists made by the Bureau of Economic Research and Statistics indicates expenditures of approximately 1.3 billion dollars. A consumer survey made by the Health Information Foundation indicated expenditures of 1.6 billion dollars for dental care for the year ending at mid-1953.

the number of people who receive emergency, protective or complete dental care. There are, however, ample signs that the effective demand for dental care is mounting steadily as a result of a growing appreciation of the value of dental health on the part of the public and an increasing recognition of social responsibility on the part of the dentist.

In future years, the development and wider application of preventive measures will reduce the need for corrective treatment of certain dental diseases. Dental caries probably will be among the first so affected because of the increasing adoption of fluoridation. The need for dental personnel will not be correspondingly reduced, however, for it has been demonstrated in other areas of medical practice that when one disease comes under control, others come into focus and receive more appropriate attention on the part of both the profession and the public.

It is unsound reasoning to assume that the demand for dental care would become equal to the need if the problems of cost and availability of service were solved. Accumulated dental need is not limited entirely to the lower income group. For example, it is common knowledge that not all indigent persons use the dental treatment facilities that are available in some communities. Also, it is well known that not all persons in the upper income groups obtain needed dental services. Although the percentage of unmet need is smaller in the upper income bracket, a large number of these persons neglect dental disease.

The economic condition of the country has a strong effect on the potential and effective demand for dental service. Data have been presented which show that the demand for dental service changes with fluctuations in national income.[11] The effective demand decreased considerably during the great depression, as shown in Table 1. Higher income, however, is not entirely responsible for the increasing demand for dental care. A steadily increasing desire for dental care as a result of dental health education of the public is causing a greater effective demand for dental service. This increased awareness of the need for dental service, in turn, is requiring a larger number of dentists in proportion to the population.

CENSUS OF DENTISTS

Dentists are now the third largest group of independent professional practitioners in the country, being outnumbered only by lawyers and physicians.

The results of surveys of dental personnel made by different agencies are not always comparable because of different base lines. Any census of dentists needs to be defined. It may be a count of all living dentists, which is a count of all persons holding the D.D.S. or D.M.D. degree. It may be a count of registered

11. Survey of current business, Office of Business Economics, 1951 National income supplement, Washington, D. C., Government Printing Office, 1951.

dentists, which is a count of all persons licensed by states to practice dentistry. It may be a count of active dentists, which is a count of all dentists in any phase of work dealing with the profession of dentistry, including administration, teaching and research. It may be a count of practicing dentists, which is a count of all dentists doing chairside work. It may be a count of private practitioners, which is a count of all dentists whose services are available to the general public.

A useful census of dentists is that of registered dentists. Five states, however, do not require periodic re-registration, and several other states do not regularly publish lists. If there were a universal system of re-registration in all states, the problem of counting dentists would be greatly simplified.

Number of Dentists • There are 93,726 dentists in the continental United States according to the 1954 edition of the *American Dental Directory* (Table 2). This is a listing as of mid-1953, including 1953 graduates. It includes all persons with the dental degree, whether or not active in the profession.

Of the total number of dentists, it is estimated that 84,000 are active in the profession and that 81,000 practice dentistry, that is, work at the chair. Approximately 75,000 are in private practice. The 1954 *Directory* lists 7,756 dentists in federal dental services.

Decennial Census Figures • In general, the United States population census count of dentists excludes dentists who are in the Armed Forces, teaching or retired. The census count comes close to being a count of private practitioners, although one other sizable group, dentists employed by the Veterans Administration (approximately 1,000 at present), is included. According to the 1950 census, there were 75,025 dentists in the experienced civilian labor force, of whom 2,076 were women.[12]

Census figures are the only basis available for comparing the change in number of dentists over a period of a decade or more. When making such comparisons, it is well to bear in mind that the number of dentists in the Armed Forces fluctuates from census to census. This detracts from the suitability of census figures as a complete measure of the growth in the profession.

Specialists • The American Dental Association recognizes seven dental specialties: oral pathology, oral surgery, orthodontics, pedodontics, periodontology, prosthodontics and public health dentistry. The requirements of examining boards in these seven specialty areas have been approved by the Council on Dental Education.

The *American Dental Directory* lists as specialists all dentists who are diplomates of approved specialty boards, members of recognized national specialty societies or licensed as specialists in the states in which they practice. The 1954 *Directory* lists 2,747 specialists, broken down as follows: orthodontists, 1,359; oral surgeons, 725; periodontists, 302; prosthodontists, 192; pedodontists, 127; oral pathologists, 22, and public health dentists, 20.

Longevity of Dentists • Dentists live approximately as long as the general white male population over 24 years of age.[13] The crude death rate of dentists in the United States is approximately 17 per thousand living dentists per year. The loss of active dentists, through death and retirement, amounts to approximately 22

12. Bureau of the Census, U. S. Department of Commerce, 1950 census of population, vol. II, part 1. Washington, D. C., Government Printing Office.

13. Bureau of Economic Research and Statistics, American Dental Association. The longevity of dentists. J.A.D.A. 39:621 Nov. 1949.

Table 2 • Distribution of dentists in the United States, 1953*

Region and state	Number of dentists	Population per dentist	Estimated population
NEW ENGLAND	6,281	1,514	9,511,700
Connecticut	1,538	1,354	2,082,200
Maine	434	2,075	900,600
Massachusetts	3,370	1,422	4,791,100
New Hampshire	273	1,990	543,300
Rhode Island	489	1,666	814,600
Vermont	177	2,146	379,900
MIDDLE EAST	25,988	1,413	36,721,100
Delaware	151	2,254	340,400
District of Columbia	769	1,071	823,600
Maryland	987	2,593	2,559,700
New Jersey	3,392	1,515	5,139,700
New York	13,441	1,133	15,232,000
Pennsylvania	6,559	1,621	10,630,300
West Virginia	689	2,896	1,995,400
SOUTHEAST	10,059	3,292	33,111,900
Alabama	808	3,852	3,112,400
Arkansas	500	3,815	1,907,400
Florida	1,470	2,157	3,170,500
Georgia	931	3,837	3,572,000
Kentucky	955	3,161	3,018,600
Louisiana	1,021	2,755	2,813,300
Mississippi	514	4,328	2,224,600
North Carolina	1,095	3,863	4,230,100
South Carolina	424	5,166	2,190,200
Tennessee	1,267	2,662	3,373,200
Virginia	1,074	3,258	3,499,600
SOUTHWEST	3,969	3,068	12,175,900
Arizona	292	2,946	860,300
New Mexico	192	3,838	736,900
Oklahoma	840	2,727	2,290,800
Texas	2,645	3,133	8,287,900
CENTRAL	24,726	1,671	41,312,600
Illinois	6,168	1,446	8,918,500
Indiana	2,023	2,048	4,143,800
Iowa	1,635	1,615	2,640,900
Michigan	3,434	1,957	6,720,200
Minnesota	2,295	1,328	3,048,200
Missouri	2,454	1,670	4,097,300
Ohio	4,243	1,937	8,217,500
Wisconsin	2,474	1,425	3,526,200
NORTHWEST	4,451	1,868	8,315,300
Colorado	805	1,780	1,433,100
Idaho	254	2,390	607,100
Kansas	964	2,100	2,024,400
Montana	318	1,895	602,700
Nebraska	952	1,429	1,360,700
North Dakota	282	2,128	600,100
South Dakota	307	2,116	649,700
Utah	420	1,752	736,000
Wyoming	149	2,023	301,500
FAR WEST	10,496	1,526	16,012,800
California	7,710	1,519	11,713,800
Nevada	90	2,016	181,400
Oregon	1,091	1,483	1,618,300
Washington	1,605	1,557	2,499,300
Total number listed by state	85,970		

Table 2 • Distribution of dentists in the United States, 1953, cont.

Region and state	Number of dentists	Population per dentist	Estimated population
FEDERAL DENTAL SERVICES	7,756		
Air Force	1,939		
Army	2,395		
Navy	2,160		
Public Health Service	281		
Veterans Administration	981		
UNITED STATES	93,726	1,677	157,161,300
TERRITORIES AND POSSESSIONS			
Alaska	43	2,992	128,643
Guam	5	11,900	59,498
Hawaii	283	1,766	499,794
Marshall Islands	1	—	—
Panama Canal Zone	9	5,833	52,498
Puerto Rico	257	8,602	2,210,703
Virgin Islands	1	26,665	26,665

*Prepared by the Bureau of Economic Research and Statistics, American Dental Association.

Sources: Number of dentists is based on a count of dentists listed in the 1954 American Dental Directory. Retired dentists are included. Populations of states and regions are estimates as of January 1, 1953, from Sales Management, May 10, 1953. Populations of territories and possessions are as of April 1, 1950. Populations of Alaska, Hawaii and Puerto Rico are from 1950 Census of Population, Advance Reports, Series PC-11, No. 1, Bureau of the Census, December 5, 1950. Populations of Guam, Panama Canal Zone and Virgin Islands are from the same series, No. 2, February 14, 1951.

per thousand active dentists per year, a current annual loss of about 1,850. The Bureau of Economic Research and Statistics currently is receiving death certificates from state departments of registration for about half of the dentists who die. Tabulations from these certificates indicated a mean age at death of 67.4 in 1951, 67.3 in 1952 and 67.3 in 1953. The certificates received, however, are not perfectly representative of all deaths of dentists, inasmuch as certain states do not participate in the program.

By far, the commonest cause of death was "diseases of the circulatory system," which accounted for 57.7 per cent of the deaths in 1951, 52.9 per cent in 1952 and 54.9 per cent in 1953. In second place was "neoplasms," with 14.8 per cent in 1951, 17.3 per cent in 1952, and 14.8 per cent in 1953.[14]

Age of Dentists • The mean age of all living (retired as well as active) dentists in the United States was 48.07 in 1949. This study was made from a sample consisting of every eighth dentist recorded in the alphabetical file of the Association's records. The standard deviation of ages was 13.40. The median age, which is less influenced by the very old dentists than is the mean, was 46.68.[15]

DISTRIBUTION OF DENTISTS

As indicated in Table 2, the ratio of population to dentist varies greatly in the different states. Also, there is a considerable disparity in the population-dentist ratio of rural and urban areas in the various geographic regions of this country.

Dentists have shown a tendency to locate in areas that offer cultural, educational and recreational advantages. Many have preferred to locate in urban areas and other localities of high per capita income where the opportunities for practice

14. Bureau of Economic Research and Statistics, American Dental Association. Causes of death of dentists by age groups, 1951, and Causes of death of dentists by age groups, 1951, 1952, 1953. Unpublished.

15. Moen, B. Duane, Bureau of Economic Research and Statistics, American Dental Association. The ages of dentists in the United States. J.A.D.A. 40:107 Jan. 1950.

and comfortable living conditions are attractive. When the states are ranked according to population-dentist ratio and per capita income in recent years, a high correlation is found to exist. Heavy concentration of dentists in metropolitan areas may cause maldistribution within a state and also a lesser income for the dentists. Dentists' incomes in larger cities are considerably below those in middle-sized cities.[6] Dentists in large cities generally treat fewer patients in a week or a year than dentists in smaller places.[5]

The effects of the concentration of dentists in larger cities are less pronounced now than in former years because of modern methods of transportation. In addition, dentists who relocated during the period 1948-1951 reversed the former tendency of selecting areas of great financial opportunity. They tended to go to states most in need of dentists rather than to states with a high per capita income.[16, 17]

Table 3 • Location of dental schools and total enrollment in 1953, by geographic region

Region and state	Number of schools	Enrollment
NEW ENGLAND	2	422
Massachusetts	2	422
MIDDLE EAST	9	3,417
District of Columbia	2	561
Maryland	1	428
New York	3	985
Pennsylvania	3	1,443
SOUTHEAST	8	1,832
Alabama	1	189
Georgia	1	310
Kentucky	1	231
Louisiana	1	212
North Carolina	1	167
Tennessee	2	517
Virginia	1	206
SOUTHWEST	2	517
Texas	2	517
CENTRAL	14	4,553
Illinois	3	1,041
Indiana	1	274
Iowa	1	208
Michigan	2	653
Minnesota	1	358
Missouri	3	904
Ohio	2	673
Wisconsin	1	442
NORTHWEST	2	302
Nebraska	2	302
FAR WEST	6	1,473
California	4	897
Oregon	1	291
Washington	1	285
Total	43	12,516

DENTAL SCHOOLS

Number of Schools • There are 43 dental schools now in operation in the United States; two additional schools are expected to enroll their first class in the fall of 1956. The Council on Dental Education is responsible for the evaluation and accreditation of these schools and has granted full approval to 40 schools and provisional approval to two. One of the schools is in its first year and has not yet been visited with a view toward accreditation. Table 3 shows the location of the dental schools now in operation and the number of students enrolled by geographic region.

Dental School Facilities • A survey of the dental school facilities and the possibilities of expansion showed that all schools are now operating at full capacity. Any increase in the number of students would require additional faculty and physical facilities. In nearly all instances, the schools also would require additional material.

In spite of the high costs of building additional facilities and the difficulty in recruiting well-trained faculty members, consideration is being given to the establishment of four additional dental schools. It has been estimated that these new den-

16. Moen, B. Duane, Bureau of Economic Research and Statistics, American Dental Association. Relocation of dentists during 1948 and 1949. J.A.D.A. 41:631 Nov. 1950.

17. Moen, B. Duane, Bureau of Economic Research and Statistics. Relocation of dentists during 1950 and 1951. J.A.D.A. 45:215 Aug. 1952.

tal education programs will be in operation by 1960.

Although the total number of applicants to dental schools has decreased slightly during the period from 1946 to 1953, there are still more than twice as many applicants as can be accommodated by the existing training facilities. Present indications are that there will be an increasing number of dental school applicants during the next few years.

Number of Graduates • The number of graduates from the dental schools has varied greatly, depending on many factors and conditions. During war years, the number of graduates in a calendar year reached a maximum of 3,587 for World War I and 3,212 for World War II. The close of both wars found the dental schools with fewer students and, as a result, the number of graduates dropped to 1,561 in 1949.

Starting with the fall of 1950, the schools were again operating closer to full capacity. In 1950-51 there were 11,891 students enrolled, of which 3,226 were freshmen. In 1953-54, the freshmen numbered 3,274, and the total number of undergraduates, 12,516, was the largest in the history of dental education in this country with the exception of one year at the close of World War I. There were about 3,000 graduates in June 1954.

In the next five years—all other factors being constant—the schools should continue to graduate about 3,000 students each year. Until such time as additional schools are started, this figure probably represents close to a maximum. It is estimated that the number of graduates who enter the profession each year is about 1,100 greater than the number of dentists lost through death and retirement.

Number of Student Failures • Because of the improvement in screening and selection procedures, the number of students who fail to complete their dental training is much less than it has been previously. For example, the student failure rate during the freshman year decreased from nearly 11 per cent in 1946 to about 4 per cent in 1952. The 4 per cent of the freshman enrollment lost in 1952 represents 130 students, but only about one half of these were dropped because of unsatisfactory scholastic achievement. There has been a corresponding decrease in the student failure rate for the four-year dental education program since 1946.

Table 4 • Percentage of dentists employing specified number and type of personnel in 1952*

Type of personnel	No. of employees			
	Part time	One	Two	Three or more
Hygienists	1.2	6.4	.2	—
Technicians	.7	3.6	.3	—
Assistants	2.3	50.8	5.2	.5
Secretaries or receptionists	1.5	15.1	.5	.0

*Moen, B. Duane, Bureau of Economic Research and Statistics, American Dental Association. Unpublished table from the 1953 Survey of Dental Practice.

Note: Employees who worked less than the full year, or who worked part time, were counted as fractions. In this table, "part time" means less than .5 employees, "one" means .5 to 1.4 employees, "two" means 1.5 to 2.4 employees, and "three or more" means 2.5 and more employees.

AUXILIARY PERSONNEL

Auxiliary personnel makes it possible for the dental profession to extend its services to a larger number of people.

"The 1953 Survey of Dental Practice"[8] indicated that 73.1 per cent of all dentists employed auxiliary personnel during 1952. The percentages of dentists employing various types of personnel are shown in Table 4. Dentists with one auxiliary aid averaged 51.7 patients during a week in April 1950[8] as compared with 37.8 patients for dentists without employees (Table 5). Dentists with one employee reported 36.8 per cent more patients than dentists with no employees, and dentists with two employees, 68.8 per

Table 5 • Average number of patients during the week of April 16-22, 1950, by number of full-time dental assistants, hygienists and technicians employed*

Employees	Patients	
	Mean	Median
0	37.8	35
1	51.7	49
2	63.8	60
3	62.8	59
4 or more	62.2	59

*Moen, B. Duane. 1950 survey of the dental profession. Chicago, American Dental Association, Bureau of Economic Research and Statistics, 1951, p. 20.

cent more patients. As the number of employees reached three or more, however, the number of patients tended to decline slightly. The 1953 survey also indicated a high correlation between number of employees and number of patients treated.

In 1948, almost two thirds (63 per cent) of the nonsalaried dentists had employees of some kind. Roughly, 42 per cent had one employee; 12 per cent had two; 4 per cent had three; 1 per cent had 4, and 1 per cent had five or more.[18]

According to the 1953 survey,[6] 41.9 per cent of dentists used one chair, 46.7 per cent used two chairs and 8.6 per cent used three chairs. The 1950 survey[5] showed considerable correlation between the number of patients per week and the number of dental chairs used. Dentists with two chairs had 26.7 per cent more patients than those with one chair. Those with three chairs had 45.2 per cent more patients than those with one chair. As the number of chairs reached four or more, the number of patients treated tended to decline slightly. Doubtless a positive correlation also exists between number of chairs and number of employees. In an analysis of patient load, however, the number of employees probably is a more potent causative factor than the number of dental chairs.

Hygienists • All states, the District of Columbia, Alaska and Hawaii have laws for the licensing of dental hygienists.

There are 31 schools for the training of dental hygienists, all offering courses of instruction of at least two years as is stipulated in the Council on Dental Education's requirements for accreditation. The number of graduates from two-year courses of instruction has increased rapidly over the past several years. For the years 1949-1953 inclusive, the numbers of graduates from such programs have been 431, 449, 575, 675 and 727 respectively. In October 1953, there were 1,794 students enrolled in schools of dental hygiene.

The 1953 survey[6] indicates that there are about 4,900 full-time dental hygienists employed by dentists and that about 6.6 per cent of the dentists employ them (Table 4). According to the Council on Dental Education, a survey of the placement of hygienists who had graduated between October 15, 1952, and October 15, 1953, showed that 78.9 per cent were employed in dental offices, 7.2 per cent in public schools and the remainder in other agencies.

In 1946, the estimated number of registered hygienists was 5,300.[19] In 1953, there were 8,506 dental hygienists registered by 29 boards of dental examiners.

The annual retirement rate of dental hygienists is approximately the same as that of other employed women. Five to six years is the average length of service.

Assistants • According to the 1953 survey,[6] dentists employ approximately 45,000 full-time assistants and 11,600 full-time secretaries and receptionists. About 56.5 per cent of the dentists employ assistants, and 15.6 per cent employ secretaries or receptionists (Table 4). In 1949,

18. Weinfeld, William. Income of dentists, 1929-48. Survey of current business, U. S. Department of Commerce, Washington, D. C., Office of Business Economics, January 1950.

19. O'Rourke, J. T. Analysis of a survey of dental hygienists in the United States. J. Am. D. Hygienists' A. 22:6 Jan. 1948.

the number of members of the American Dental Assistants Association was 6,500.[20]

Technicians • The 1953 survey[6] shows that about 3.9 per cent of dentists employ about 3,000 full-time dental technicians (Table 4). The National Association of Dental Laboratories estimates that there are 6,800 dental laboratories employing about 20,000 technicians.[21] In 1948, there were 14,286 dental laboratory technicians.[22] Training schools and apprenticeship programs in laboratories make roughly 2,000 available for employment each year.

Available information indicates that the number of newly trained laboratory workers exceeds the number who die or retire each year. A shortage of dental laboratory technicians is not anticipated unless large numbers are called for military service.[22]

DISCUSSION

The public's desire and demand for dental care will increase at an accelerated rate in the future. This upward trend is the result of educational activities and of the emphasis being placed on health standards by the military.

The trend in the amount of dental care being dispensed also is upward. During the past decade, however, the supply of dentists and hygienists has not kept pace with the public demand for services.

In developing long-range plans for training dentists and auxiliary personnel, consideration must be given to the dental manpower needs of the Armed Forces. Present policies require a ratio of 1.9 dentists to 1,000 members of the Armed Forces. During World War II, more than 25 per cent of the active dentists in this country served with the Armed Forces. The current international situation gives every reason to believe that the number of military personnel will remain high for a considerable period of time and, therefore, that the need for dentists in the Armed Forces also will be great for the years immediately ahead. In all probability, these military needs will affect the dental manpower requirements for the civilian population. A call to military service in times of emergency should not deplete the reservoir of dental personnel to the extent that the dental health of the civilian population is seriously impaired.

Increase in dental personnel to meet all of the oral health needs of all people is completely beyond the realm of possibility for the years immediately ahead. For the future, however, the wider application of preventive measures may help considerably to lessen the disparity between needs for dental care and the number of personnel available to meet these needs.

In over-all numbers, there probably are enough dentists to meet the effective demand in urban areas. In other words, the supply of dentists in most urban areas has kept pace with the demand for their services. In terms of equitable ratios, however, some localities have an oversupply of dentists and others an undersupply.

Rural areas have fewer dentists per unit of population than have metropolitan areas. The data on the number of dentists in rural counties is likely to be misleading, however, so far as the availability of dental care is concerned. With the great improvement in transportation facilities, the distribution of dentists by counties has little meaning in determining personnel needs. Also it would appear that to date dental health education in many states has not been stressed as much

20. Personal communication from Steve Ann Montgomery, general secretary, American Dental Assistants Association, May 5, 1950.

21. Stone, Paul A. National Association of Dental Laboratories. Personal communication to B. J. Conway. American Dental Association, September 1954.

22. Peterson, S. A. Manpower, the heart of any program for dental health, J.A.D.A. 38:514 April 1949.

in rural areas as it has been in the metropolitan areas. The indications are, however, that there is a need in many rural areas for additional dental personnel to meet the existing effective demand for dental services.

The people's recognition of the need for more dentists, particularly in some states, is shown by the legislative action in recent years in four states (Washington, Alabama, North Carolina and West Virginia) in appropriating funds for four dental schools.

With the exception of the depression period, the supply of dentists has no more than kept pace with the demand for their services. In all probability, the effective demand will be increased at an accelerated rate as a result of the present emphasis on dental health in public health activities. In view of an anticipated increase in the effective demand and the shortage of dentists in many rural areas, an additional supply of dentists is needed, especially in those areas where the ratio of population to dentists is greater than the national average of 2,100 civilians to each civilian dentist.

Steps to increase the number of dentists should be supplemented by increased public education and the fullest possible use of accepted preventive procedures. Practical steps also should be taken to assist dentists in locating in areas in need of dental personnel. An example of such a plan is the dentist placement program approved by the Virginia State Dental Association in April 1954.[23] The program, designed to meet the need for dentists in rural areas and small towns, is sponsored by the Virginia Council on Health and Medical Care, a privately supported voluntary organization. Under the program, the Council will act as a placement center through which communities can contact dentists seeking locations for the establishment of practice. In communities where the Council has stimulated the construction of small clinic buildings to attract physicians, facilities can be added for dentists.

Dentists seeking locations can also obtain assistance in the way of information from the American Dental Association. The Association's Bureau of Economic Research and Statistics has prepared two booklets that are revised periodically to provide current data.[24,25]

The growth of public dental health programs during the past 20 years has created new positions for dentists and hygienists. Many of these positions are vacant. A further expansion of local and state health programs will create additional demands for dental personnel.

Neither past experience nor formal studies has produced a formula by which desirable ratios of dental hygienists to dental practitioners and to population can be established definitely. It is a generally accepted fact, however, that the demand for hygienists greatly exceeds the supply. Additional schools that have been established within the past three years for the training of dental hygienists are likely to make the need less acute during the next few years.

SUMMARY

1. Although it would be desirable to make dental care available to every person who needs and wants such care, the size and nature of the dental disease problem present formidable barriers to the attainment of this goal.

2. A sufficient number of dental personnel to meet all existing dental needs is beyond attainment through any prac-

23. News of dentistry. Plan to staff rural areas endorsed by society. J.A.D.A. 48:728 June 1954.

24. Moon, B. Duane. Distribution of dentists in the United States by state, region, district and county. Chicago, American Dental Association, Bureau of Economic Research and Statistics, 1954.

25. Moon, B. Duane. Facts about states for the dentist seeking a location. Chicago, American Dental Association, Bureau of Economic Research and Statistics, 1954.

tical means. Furthermore, even if it were possible to train sufficient dentists to make dental care available to everyone, such a large number of dentists would not be warranted, and their time would not be utilized fully because of the wide disparity between need and effective demand for dental care.

3. It has been roughly estimated that the effective demand for dental care is about a tenth of the total need for dental service. All signs indicate, however, that the effective demand per unit of population is increasing. Continued emphasis on the importance of dental health, together with the increased dental health education activities, undoubtedly will result in a sustained upward trend in the effective demand for dental care.

4. Although the number of dental graduates exceeds the number of dentists who die or retire, the population in recent years has been increasing at a greater rate than has the number of dentists. If this trend continues, there will not be enough dentists to keep pace with the growing demand for dental care.

5. Available evidence indicates that when the population-dentist ratio in a given area is about that of the national average, the number of practicing dentists usually is sufficient to meet the current effective demand for dental care. Additional dental manpower will be needed in the years immediately ahead, however, because of the increasing demand for dental care, the demand for dentists for military service and public health work and the need for dentists in many rural sections.

6. The location of more dentists than heretofore in rural areas and the continued improvement of transportation facilities are helping to relieve the problem of the shortage of dentists in many rural sections. Various plans have been developed by rural groups to bring dental services to their areas. Additional practical plans should be devised, however, to supply dental personnel in areas of need where a demand for dental service exists.

7. Available information does not disclose the extent of need for additional dental assistants. However, the establishment in recent years of a number of courses for dental assistants is indicative of the increasing recognition of the value of trained dental assistants. Comprehensive studies should be undertaken to determine the need for training additional dental assistants.

8. The supply of dental laboratory technicians seems to be adequate to meet existing requirements.

9. At its 1950 annual session, the Association adopted a resolution urging appropriate dental educational agencies to conduct undergraduate and postgraduate courses for dentists and assistants which would enable them to work together more effectively in the providing of more dental services to a larger number of people. The intent of this resolution may be fulfilled either through the establishment of new courses or through the expansion and development of existing courses. In addition, comprehensive studies should be continued in developing better methods for using dental office and chairside auxiliary personnel.

BUREAU OF LIBRARY AND INDEXING SERVICE

Additions to the Library

The books listed here have been added recently to the Library collection. Requests for this material, available on loan to all members of the Association, should be addressed to the Bureau of Library and Indexing Service. There is no charge for borrowing books. Most of the books may be purchased also through the Library.

BOOKS

AMERICAN DENTAL ASSOCIATION. BUREAU OF ECONOMIC RESEARCH AND STATISTICS. Facts about states for the dentist seeking a location. Chicago, The Association, 1954. 34 p.

AMERICAN DENTAL ASSOCIATION. BUREAU OF LIBRARY AND INDEXING SERVICE. Audio-visual materials in dentistry. Chicago, The Association, 1954. 44 p.

AMERICAN DENTAL ASSOCIATION. BUREAU OF LIBRARY AND INDEXING SERVICE. Index to dental literature, January-June, 1954. Chicago, The Association, 1954. 119 p.

AMERICAN DENTAL ASSOCIATION. COUNCIL ON DENTAL EDUCATION. Workshop on dental specialties. Chicago, The Association, 1954. mimeo.

AMERICAN DENTAL ASSOCIATION. COUNCIL ON DENTAL HEALTH. Summary of available information on prepayment dental care plans. Chicago, The Association, 1954. 56 p.

AMERICAN SOCIETY FOR THE ADVANCEMENT OF GENERAL ANESTHESIA IN DENTISTRY. Proceedings, spring meeting, 1954. New York, The Society, 1954. 59 p.

APPLEGATE, OLIVER. Essentials of removable denture prosthesis. Philadelphia, Saunders, 1954. 323 p. $10.

BIERMAN, H. R. Cancer learning in the dental school. San Francisco, University of California, 1954, 141 p.

BJORLIN, GUNNAR. Influence of local anaesthetics on living tissue in white rat. Odontologisk Revy Vol. 5 Sup. 2. Lund, Sweden, University of Lund, 1954. 112 p.

BONICA, J. J. Management of pain. Philadelphia, Lea & Febiger, 1953. 1,533 p. $20.

BOURGOYNE, J. R. Oral cancer, with chapters by David S. Carroll and Ralph S. Lloyd. Philadelphia, Lea & Febiger, 1954. 295 p. $6.50.

BRASIER, STANLEY. Maxillo-facial laboratory techniques and facial prostheses. London, Kimpton, 1954. 232 p. $7.

COOLIDGE, E. D. & HINE, M. K. Periodontia; clinical pathology and treatment of the periodontal tissues, 2d ed. Philadelphia, Lea & Febiger, 1954. 384 p. $7.50.

DUBRUL, E. L. & SICHER, HARRY. The adaptive chin. Springfield, Ill., Thomas, 1954. 97 p. $3.50.

FILM COUNCIL OF AMERICA. A guide to film services of national organizations. Evanston, Film Council of America, 1954. 146 p. $2.

GERSON, MARK. The elements of dental therapeutics and anaesthesia. London, Kimpton, 1954. 91 p. $2.10.

HARCLEROAD, FRED. Audio-visual administration. Dubuque, Iowa, Brown, 1951. 118 p. $3.25.

LANDA, J. S. Practical full denture prosthesis. London, Kimpton, 1954. 501 p. $9.

LUCAS, R. B. Bacteriology for students of dental surgery. London, Churchill, 1954. 262 p. $4.50.

MEAD, S. V. Oral surgery. 4th ed. St. Louis, Mosby, 1954. 1,478 p. $25.

MICHIGAN. UNIVERSITY. A workshop to study the organization of private practice for the extension of scientific dental health service to more people. Evaluating Committee reports. Ann Arbor, University of Michigan, 1954. 189 p.

MILES, MADELINE. Do you know your cleft palate child. [Bradford, Pa.?] Author, 1953. 15 p.

NATIONAL RESEARCH COUNCIL. NATIONAL ACADEMY OF SCIENCES. Problem of providing optimum fluoride intake for prevention of dental caries. Washington, National Research Council, 1953. 15 p. $0.50.

NEW YORK STATE DENTAL SOCIETY. Annual meeting of the Board of Governors. Proceedings. New York, The Society, 1953. 83 p. mimeo.

NORTHWESTERN UNIVERSITY DENTAL SCHOOL. Analysis and treatment of the stomatognathic system; a symposium presented at Northwestern University, Thorne Hall, Chicago Campus, on April 1, 2 and 3, 1953. 113 p.

ONTARIO DENTAL ASSOCIATION. DENTAL PUBLIC HEALTH COMMITTEE. Your child and mine; the story of dental health. Toronto, The Association, 1952. 40 p.

READING DENTAL SOCIETY. History of free and part free dental dispensary services provided by the Reading Dental Society, 1909-1952. Pennsylvania, Reading Dental Society, 1953. 32 p.

RIPMAN, H. A. Guy's hospital, 1725-1948. London, Guy's Hospital Gazette Committee, 1951. 175 p. $3.75.

SARTON, GEORGE. Introduction to the history of science. Baltimore, Williams & Wilkins, 1947. Vol. 3, Pt. 1, 1,018 p.; Pt. 2, 2,155 p. $20.

SCHLOAT, G. W. Your wonderful teeth. New York, Scribner, 1954. 46 p. $2.25.

SCHWARZROCK, L. H. Effective dental assisting. Minneapolis, Loren, 1954. 379 p. $7.

STONES, H. H. Oral and dental diseases; aetiology, histopathology, clinical features, and treatment. 3d ed. London, Livingstone, 1954. 1,019 p. $18.

U. S. COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE. Hearings on H. R. 2341, a bill to protect the public health from the dangers of fluorination of water, May 25, 26, 27, 1954. Washington, Govt. Print. Off., 1954, 491 p.

WANNENMACHER, EUGEN. Zahnärztliches Taschen-Jahrbuch, 1954. Munich, Pflaum, 1954. 496 p. $3.

WOODRUFF, W. F. A. Surgery for dental students. Oxford, Blackwell, 1954. 326 p. $6.50.

The American Dental Association Film Library

The following films and filmstrip have been added to the American Dental Association Film Library since the publication of the brochure, *Audio-Visual Materials in Dentistry*. The films are available from the Film Library at a nominal rental fee of $2.50 each and the filmstrip at $1.

FILMSTRIP AND FILMS RECEIVED

Brush Up On Your Teeth • filmstrip, 35 mm., color, 29 frames with guide. Produced in 1949 by the Dental Health Division of the Department of Health and Welfare, Canada. Procurable on loan ($1) from the American Dental Association Film Library, 222 E. Superior St., Chicago, and on purchase ($5) from Stanley Bowmar Company, 513 W. 166 St., New York.

Causes of tooth decay, methods of prevention and the ingredients of a well balanced diet are explained to grade school children in a classroom atmosphere. (Suitable for lower primary grades. It can also be adapted to preschool age groups.)

Hazards of Dental Radiography • 16 mm., color, sound, 13 min. Produced in 1953 by the National Bureau of Standards and the American Dental Association. Procurable on loan ($2.50) from the American Dental Association Film Library, 222 E. Superior St., Chicago, and on loan or purchase ($67.85) from the Office of Scientific Publications, National Bureau of Standards, Washington, D.C. Purchase price is subject to change without notice.

Methods of avoiding the hazards of dental roentgen rays and how these methods can be applied to actual roentgenographic procedures in the dental office are shown. (Suitable for dental students, general practitioners, radiologists and professionals using roentgen rays.)

Immediate Endodontics and Periapical Surgery • 16 mm., color, sound, 30 min. Produced in 1953-54 by John I. Ingle, D.D.S., M.S.D., and the University of Washington School of Dentistry with the cooperation of E. R. Squibb & Sons. Procurable on loan ($2.50) from the American Dental Association Film Library, 222 E. Superior St., Chicago, on loan ($1) from the University of Washington School of Dentistry, Seattle, Wash., and on free loan from E. R. Squibb & Sons, 745 Fifth Ave., New York.

A pulpless anterior tooth with a periapical granuloma undergoes endodontic therapy that consists of canal enlargement, sterilization and obliteration, and finally periapical surgery. (Suitable for dental students, general practitioners, endodontists and oral surgeons.)

COUNCIL ON DENTAL RESEARCH

Additions to and deletion from List of Certified Dental Materials

Since the publication of the most recently revised List of Certified Dental Materials (revised to November 15, 1953), the following materials which conform to the A.D.A. Specification No. 12 for Denture Resins have been added.

CERTIFIED DENTURE RESINS (A.D.A. SPECIFICATION NO. 12)

TYPE I, HEAT-CURING

Material	*Form*	*Manufacturer or distributor*
Densene 33-Varihued	Pink; powder-liquid	Cosmos Dental Products Co.

TYPE II, SELF-CURING

Acralite 88-True Life	Pink; powder-liquid	Acralite Co., Inc.

The A.D.A. Research Fellowship, National Bureau of Standards, has been advised by the manufacturer of the following material that they no longer manufacture this product and, therefore, it should be eliminated from the List of Certified Dental Materials:

CERTIFIED DENTURE RESINS (A.D.A. SPECIFICATION NO. 12)

Material	*Form*	*Manufacturer or distributor*
Crystolex, Regular	Pink; powder-liquid	Kerr Manufacturing Co.

LON W. MORREY, D.D.S., EDITOR
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THE Journal OF THE AMERICAN DENTAL ASSOCIATION

Editorials

Relief Fund

This month's cover of THE JOURNAL is used, as November covers have been for several years past, to focus attention on the Association's Relief Fund program. This year's design—three seals one above the other—will appeal to every member's imagination as exceptionally appropriate, illustrating the mounting interest of the profession in the program and symbolizing assurance that the seal sale again will go over the top.

Each year at this time members receive a small packet of Relief Fund seals and an invitation from the Council on Relief to contribute to the Fund. For the past two years the response has been so generous that the Council's modest goal of $100,000 has been passed. It is hoped that the response this year will be so heavy that the Council will be forced to raise its goal.

For members who are somewhat in the dark regarding the purpose, need and mechanism of the American Dental Association Relief Fund the following high lights are provided:

The American Dental Association Relief Fund is a perpetual charitable trust protected legally from attachment.

The sole purpose of the program is to aid dentists and their families in distress.

One half of every contribution received is returned to the constituent society from which it originated, and half is deposited in the Relief Fund of the Association.

All administrative costs are paid by the Association allowing every dollar contributed to the Relief Fund to go for relief purposes.

Only the interest from the Association's Relief Fund can be used; the principal must be kept intact.

Any dentist in need or his dependents may apply for financial assistance.

When an application is approved the applicant receives a financial grant, half of which is paid by the Association's Relief Fund and half by the constituent and component society in whose jurisdiction the applicant resides.

The Relief Fund now amounts to approximately $800,000.

Last year the interest from the Fund covered, with a few dollars to spare, the Association's share of relief grants.

Because living costs for relief recipients, as for others, have increased, more liberal contributions are needed and urged.

Therefore, this year please write a little larger check for your Relief Fund seals or add a few extra dollars to your cash contribution.

Boost the stamps off the top of the front cover and boost your own self-esteem by raising your contribution to this year's dental Relief Fund program.

Restoring warped words to their original meaning

Some old technical words, through long and indiscriminate use, stray from their original and useful meanings, and become indeed Troublesome Terms. A case in point came up in the recent nomenclature conference, held last September 3 and 4, sponsored by the Association.

The terms *articulate, articulation* and *articulator* have been employed in the parlance of the denture prosthetist for over one hundred years. The original sense of the word *articulation,* which is much older than its prosthetic usage, is that of an anatomic joint. However, in prosthetic dentistry the term has come to mean, in the literature and as defined in dictionaries, either the relations of the occlusal surfaces of the upper and lower teeth in contact, especially in movements of the jaws, or arrangement of the artificial teeth in a denture to simulate such relations. These interpretations are predicated on the assumption that there is an analogy between the contacts of teeth during mastication and the relations of the parts within a joint. Nothing could be less descriptive.

A review of the terms as used and defined convinced some members of the conference that *articulate, articulation* and *articulator* should be discarded and should be superseded by such terms as *occlude, occlusion* and *occluding frame* or *occluder.*

The happy thought of a leading prosthodontist presented an alternative. If the false analogy of tooth relations were dropped and the true analogy of a joint were

reverted to, the old terms, it was suggested, might still be retained as useful symbols for procedures essential to the construction of dentures. In consequence, the three following definitions were developed:

The *articulator* is a mechanical device representing the temporomandibular joints, and usually adjustable to simulate various of the individual characteristics of a patient's (or subject's) joints.

To articulate intraoral casts of a patient's jaws is to relate them in an artificial mechanical device representing the temporomandibular joints, usually adjusted to correspond in various respects to the joints of a patient, and thus enabling the dentist to duplicate some of the movements of the patient's mandible.

Articulation (as an active noun) is the relating of upper and lower intraoral casts of the jaws, by means of an artificial joint device (or articulator) adjusted to correspond in various respects to the joints of the patient (subject), and thus enabling the dentist to duplicate some of the movements of the patient's mandible.

These new concepts and new definitions of the terms in question, which are really reversions to the original meanings, omit any consideration of the teeth and involve only the relations of the jaws, joined by the temporomandibular articulations, when at rest or in function. Thus, the terms become truly descriptive and useful, without invading the concepts of phenomena covered by the term *occlusion*.

These definitions have been here presented for the consideration of the profession. It is hoped that practicing dentists, dental educators, authors and editors will give expression to their reactions to these terms and their definitions, and in this way aid in the improvement of scientific dental terminology.

Dental manpower: a tale of two countries

Attention is called to two reports in this issue of THE JOURNAL dealing with dental manpower. One concerns Great Britain, one the United States. Considered separately, each is valuable in its own right from an informational standpoint. Considered in unison, they offer good grounds for speculation regarding the effect of different socioeconomic patterns on the health and welfare of a nation.

This month's British news letter (page 620) reports that old age is overtaking dentistry in Britain. Of the 15,075 dentists registered there, 6,170 or 41 per cent are over age 56. Only 3,418 or 22 per cent are under age 36. The *British Dental Journal*,[1] deploring this condition, states: "there is every reason for thinking that the actual position is even worse than appears because all the estimates and assumptions that have been used are on the most conservative basis." Prospects for the future are even darker according to another report[2] since many of the British dental schools have vacancies and there is no sign of any increase in the rate of recruitment. If the present loss through death and retirement continues and if nothing is done to stimulate recruitment, the *British Dental Journal*[1] estimates that by 1964—ten years hence—

the profession will sustain a loss of 5,000 members against a gain of only 3,000 replacements, not a cheerful prospect in view of the growing demands for dental service.

By contrast the future of the dental profession in the United States is bright. According to a joint report of the Council on Dental Health, Council on Dental Education and the Bureau of Economic Research and Statistics (pages 582 to 593 of this issue) there are 93,726 dentists in continental United States. Of these 84,000 are active in some phase of the profession, 81,000 being actively engaged in practice at the chair.

The age distribution of dentists in this country, unlike that of Great Britain, presents little problem. According to the 1950 population census,[3] of approximately 75,000 United States dentists, 20,185 or 27 per cent were over age 54. Twenty-seven per cent were between 45 and 54, 24 per cent were between the ages of 35 and 45 and 22 per cent were under 35. Thus it appears that despite the military, socio-economic and other upsets that have affected this country, the United States has approximately the same number of dentists in each ten year age group, in marked contrast to the situation in Great Britain.

The future of dentistry in the United States and the prospects of a continual rise in American dental health standards seem assured. The country's forty-three dental schools are filled to overflowing. Two new schools are expected to open in 1956, and four additional schools are contemplated by 1960. There are more than twice as many applicants for dental education as can be accommodated by existing training facilities. Last year there were 12,516 undergraduates enrolled in the dental schools in the United States of whom 3,000 were graduated last June. Barring some unforeseen contingency, the schools should continue to graduate approximately 3,000 annually for the next five years after which the number should be increased to some extent. On that basis the number of graduates entering the profession annually exceeds the number lost through death and retirement by about 1,100. This number is not sufficient to maintain the present population to dentist ratio, but the continued increase in the number of dental graduates and the prospect of additional dental schools foreshadows a more nearly adequate fulfillment of the demand for dental service in the future.

Many reasons exist for the difference in the status of dentistry in Great Britain and the United States—countries which in so many respects have so much in common. Chief, perhaps, among these reasons are the unscientific ministrations of a government which has assumed the role of faith healer. Invariably the laying on of hands by such a body injures rather than aids the ailing patient.

What has happened to dentistry in Britain must not happen to dentistry here.

1. Association news sheet. British Dental Journal 97:36 Sept. 7, 1954.
2. News from Great Britain. J.A.D.A. 49:253 Aug. 1954.
3. Health manpower source book, U. S. Department of Health, Education and Welfare, Public Health Service. Washington, D. C., Government Printing Office.

Washington News Letter

Under their voluntary procurement programs, the Army, Navy and Air Force have placed some 900 young dental officers on active duty within recent weeks, the great majority of them members of this year's graduating classes.

Of the three services, the Navy, which obtained 450 graduates, was most successful in its voluntary procurement. Its dental personnel requirements are now taken care of until June 1955. The Air Force commissioned 350 which, together with 150 scheduled to be supplied in December through Selective Service, will fulfill its estimated needs through June.

Least successful in recruitment of 1954 graduates was the Army, which commissioned only 89. As a result, the Army was compelled to send a requisition to Selective Service calling for 279 for induction in December.

Figures compiled by Selective Service headquarters indicate that, in filling Army and Air Force draft calls for December, it will be necessary to call many special registrants in Priority III. As of August 31, the latest date for which figures are available, Priorities I and II combined had only 197 registrants who were in 1-A and pronounced physically qualified for military duty.

LABORATORY CONFERENCE

The Washington conference October 12-14 of heads of the Army's five central dental laboratories was termed so successful by participants that plans are now being made to conduct such meetings on a regular annual basis.

Information was exchanged on such subjects as standardization of technics and materials, training of personnel and record keeping.

The conferees were addressed by Maj. Gen. Oscar P. Snyder, chief of the Army Dental Corps; Col. George Jeffcott, his assistant, and Brig. Gen. Arthur L. Irons, director of dental activities at Walter Reed Army Medical Center, where the sessions were held. Commanding officers of the central dental laboratories who attended were Col. Dean S. Beiter, Fort McPherson, Georgia; Col. Lynn C. Dirksen, Washington, D. C.; Col. Howard N. Burgin, Fort Sam Houston, Texas; Lieut. Col. Maurice E. Washburn, St. Louis, and Lieut. Col. William P. Barnes, Jr., Alameda, Calif.

A 22 page monograph on preparation of tooth sections for microscopy, with photographs and schematic drawings, has been made available for distribution by the Office of Technical Services, U. S. Department of Commerce. The report is based on developmental work conducted at the National Institutes of Health.

It describes the making of ground sections of teeth with a three-inch abrasive wheel which has a speed of 1,129 rpm and which makes possible a fine finish and allows penetration of the enamel without chipping. A counterbalanced pivot arm controls cutting at the desired rate to obtain sections free from cracks and of uniform thickness. A new apparatus for sizing and polishing of the sections utilizes an automatic lapping technic. Commercially produced parts used in the equipment are identified and their sources are listed.

Identified as Report No. PB 111471, it is purchasable for 75 cents from the Office of Technical Services, Room 6227, Department of Commerce Building, Washington 25, D. C.

HEALTH PLAN SURVEY

A survey of independent health plans throughout the country has been completed by a federal agency. The report

discloses that nearly 600,000 persons are eligible for some dental care benefits under coverage of this kind.

The plans studied are of the prepaid type which are not associated with Blue Cross, Blue Shield or commercial carriers. Many of them are group practice clinics, some of which serve members of labor unions exclusively.

Questionnaires replying for 299 plans were received up to July 30 of this year. These questionnaires were processed by the Division of Research and Statistics in the Social Security Administration, a bureau of the Department of Health, Education and Welfare. The 299 plans provide medical, surgical, dental or hospital coverage for nine million persons, divided almost equally between the insured persons and their dependents.

With reference to dental coverage, it was found that 425,000 persons with 170,000 dependents are beneficiaries of employer-employee groups and union plans. By types of plans, the 595,000 eligibles are divided as follows: employer-employee groups, 363,000; union, 62,000; community-wide, 147,000; consumer, 14,000; fraternal, 9,000.

An official announcement was made by the U. S. Air Force that it has introduced water supply fluoridation at one of its bases, thereby gaining the distinction of becoming the first military branch to adopt this innovation.

The number one installation is Ramey Air Force Base in Puerto Rico, which has its own water supply. A large number of dependents, including infants and young children, live on the base.

Association Affairs

PAUL ZILLMANN APPOINTED COUNCIL SECRETARY

Paul W. Zillmann, of Buffalo, has been appointed secretary of the Council on Insurance, Harold Hillenbrand, Association secretary, announced in October. Dr. Zillmann will serve without compensation for a term of one year following the annual session. This will be the first time that the Council will have a secretary who is not a Council member. Dr. Zillmann's term as a member of the Council on Insurance expires this year. The position was made necessary by the increased activities of the Council.

Dr. Zillmann was active in the recent successful drive to enroll enough Association members in the Group Accident and Health Insurance program to make coverage available to insurance applicants regardless of their previous medical history. He has served the Association also as chairman of the former Committee on Membership.

GOAL OF $100,000 SET FOR RELIEF FUND DRIVE

A goal of $100,000 has been set for the 1954-55 Association Relief Fund drive, which opened formally November 1. On that date, Relief Fund Seals were mailed to members of the dental profession throughout the United States. Last year the national quota of $100,000 was surpassed for the second time in a row. A record was set with a total contribution of $105,996.75; 39 constituent societies reached or exceeded their goals.

Contributions to the current drive will be reported in two separate listings: one for societies with quotas over $925 and one for societies with quotas of $925 or less. In the 1953-54 drive smaller societies reached 122 per cent of their quota; the larger ones 102.8 per cent.

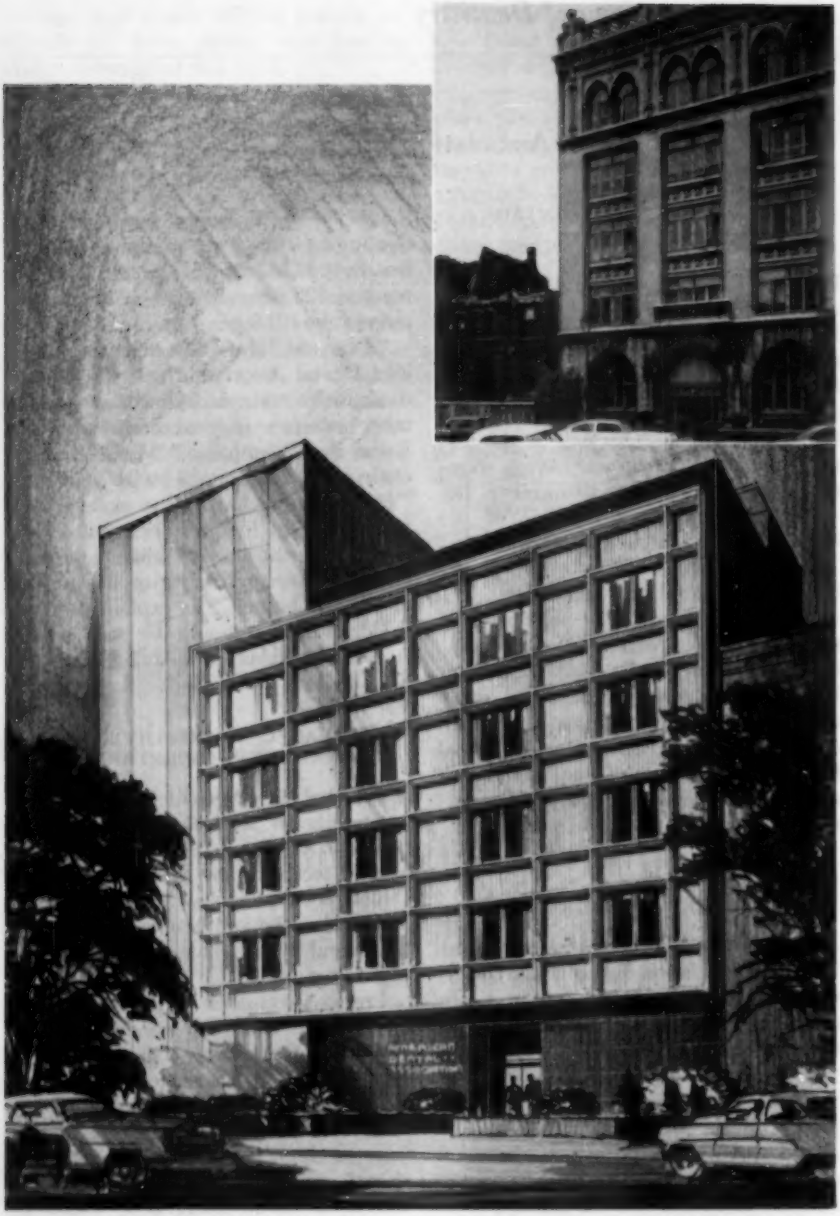
"This year, for the first time, the American Dental Association will pay all administrative costs, including postage and other expenses in connection with the Relief Fund campaign," M. C. Hansen, chairman of the Council on Relief, stated. "This means that every dollar contributed to the fund will be used to help a fellow dentist who is unable to provide even the bare necessities of life for his family and himself," he explained.

Contributions should be sent to the Association Relief Fund, 222 E. Superior St., Chicago 11.

SPENADEL AWARD GIVEN ASSOCIATION SECRETARY

The fifth Henry Spenadel Award, given for significant service to dentistry, was presented to Harold Hillenbrand, Association secretary, by the First District Dental Society of New York October 4. The gold medal and scroll were presented by Roland Morse, chairman of the award committee.

Previous recipients of the award were Arthur H. Merritt, president of the American Dental Association for 1939-40; William J. Gies, biochemist noted for contributions to dental education and research; Frederick S. McKay, a pioneer in research on fluorides for prevention of dental caries, and William D. Coolidge, developer of an x-ray tube which increased the safety and reliability of x-ray equipment.



Inset: Demolition proceeds on the building next to the Central Office to make room for addition to the headquarters building. Below: Architect's sketch of the new Central Office.

BOARD APPROVES BUILDING PLANS FOR CENTRAL OFFICE, APPOINTS COUNCIL CONSULTANTS

Plans for the expansion of Central Office facilities through construction of an addition to the present headquarters building were approved by the Board of Trustees at a meeting held in the Central Office September 27-29. In other actions, the Board approved consultants to the various Councils and reviewed matters to come before the House of Delegates at the 95th annual session in Miami November 8-11.

CENTRAL OFFICE EXPANSION

In addition to the six story, basement plus penthouse to be constructed west of the present Central Office, building plans approved by the Trustees include refacing and rehabilitation of the present structure. The old and new unit will have a common facade of contemporary design, combining grey stone, black granite and aluminum in varying shades of grey.

According to the architect's design a "grid" of aluminum panels, horizontal and vertical "fins" and pivot windows are complemented by a stone pylon at the west side of the new building. The grid is framed by a black granite base and field.

The entire structure is to be air conditioned, the lobby remodeled, a second passenger elevator constructed, new heating plant and modern lighting installed. The Board Room will be enlarged, and additional facilities for the efficiency of Central Office staff are to be constructed.

The new addition to the building is to be a fireproof steel skeleton construction, with acoustical ceilings, plaster walls, asphalt tile floors and recessed fluorescent lighting.

The six story addition will be 25 feet wide and 125 feet deep and will connect through the west wall of the present building at each floor level. A sixth floor will be constructed on the present building. The 25,000 square feet in the new structure plus the addition to the present building will result in a near doubling of floor space. Actual construction is scheduled to be completed in the late fall of 1955. The construction cost is estimated at approximately 800,000 dollars.

COUNCIL CONSULTANTS

Consultants approved for the Council on Dental Education for terms ending with the 1955 annual session were:

Leroy R. Boling, Ph.D., dean of the School of Dentistry, Washington University (St. Louis); James Burrill, assistant professor, The Dental School, Northwestern University; Nicholas J. Brescia, Chicago College of Dental Surgery, Loyola University; Franklin B. Gurney, M.S., Chicago College of Dental Surgery, Loyola University; John V. Lenburg, The Dental School, Northwestern University; Clarence M. Peebles, Ph.D., The Dental School, Northwestern University, and Roy Ellis, dean of the Dental School, University of Toronto.

Approved as consultants for the Council on Dental Health were:

Paul E. Boyle, University of Pennsylvania; Kenneth A. Easlick, School of Dentistry, University of Michigan; Donald J. Galagan, Division of Dental Public Health Service in Washington, D. C.; Touro M. Graber, Northwestern University; Irving R. Hardy, Tufts College; Raymond E. Johnson, periodontist of St. Paul; Robert G. Kesel, University of Illinois; Maury Massler, University of Illinois; Isaac Schour, University of Illinois; Nina Simmonds, University of California, and Gerald Stibbs, University of Washington.

Named consultants for the Council on Federal Dental Services were:

James P. Hollers and Thomas P. Fox, members of the advisory committee to the Assistant Secretary of Defense, and Leo J. Schoeny, dental consultant to the Office of Defense Mobilization. Russell W. Bunting, dental consultant to the Federal Civil Defense Adminis-

tration, was named consultant to the Subcommittee on Civil Defense.

Consultants for the Council on Registry of Dental and Oral Pathology are:

Joseph L. Bernier, Washington, D. C.; Lester Cahn, New York; Elbert DeCoursey, Washington, D. C.; Henry Goldman, Boston; Donald A. Kerr, Ann Arbor, Mich.; H. B. G. Robinson, Columbus, Ohio, and Henry A. Swanson, Washington, D. C.

The Board approved the following men as consultants for the Council on Dental Research:

Wallace D. Armstrong, M.D., Minneapolis; Herbert D. Ayers, Flushing, N. Y.; Harold C. Hodge, Ph.D., Rochester, N. Y.; Seymour Kreshover, Richmond, Va.; Miles R. Markley, Denver; Harold J. Noyes, Portland, Ore.; Ralph Phillips, B.S., Indianapolis; Reidar F. Sognnaes, Boston, and W. Ward Wainwright, Los Angeles.

Consultants appointed to the Council on Dental Therapeutics were:

Jack B. Caldwell, Washington, D. C.; Mary C. Crowley, M.S.P.H., Ann Arbor, Mich.; Wendell H. Griffith, Ph.D.; S. C. Harris, Ph.D., Chicago; Max S. Sadove, M.D., Chicago, and Helmut A. Zander, Minneapolis.

COUNCIL GATHERS DATA ON STUDENT SERVICE STATUS

Basic data on military service status of dental students is to be gathered in a survey now being conducted by the Council on Dental Education for the Department of Defense and the Health Resources Advisory Committee of the Office of Defense Mobilization. Results of the survey will be used as partial basis for future planning by the government in attempting to meet the needs of the Armed Forces for professional personnel. An attempt will be made to give consideration to the preferences of students as to time of entry on active duty and service preference.

Results of the survey will be available about the first of the year.

JANUARY DATE SET FOR STATE SECRETARIES' MEETING

January 17-19 are the dates set for the Seventh State Secretaries' Management Conference to be held at the Central Office, Louis M. Cruttenden, Association assistant secretary, has announced. The theme of the meeting and program details will be announced later.

DENTAL HEALTH WEEK FILMS SHOULD BE ORDERED NOW

Dental societies planning on using films, slides or film strips for Children's Dental Health Week should send in their requests immediately as only a limited number of prints are available, the Film Library has announced. Films available from the Library are listed in the recently published brochure *Audio-Visual Materials in Dentistry*, which may be obtained from the Bureau of Library and Indexing Service at the Central Office.

TEACHING HOURS, MILITARY STATUS OF FACULTIES TOLD

Preliminary information compiled from a recent survey of dental school faculties shows that of 2,810 dental school teachers, 28 per cent devote full time to the dental school. Of the clock hours taught in the schools, nearly 60 per cent are taught by full-time faculty members. The survey was made by the Council on Dental Education in cooperation with the National Health Resources Advisory Committee of the Office of Defense Mobilization.

The survey also revealed that 80 per cent of the faculty members hold dental degrees and that 70 per cent of the group have had previous military experience. Further details of the study will be reported when all the information has been tabulated.

The survey is intended to help the Office of Defense Mobilization judge the

Water skiing is a favorite sport in Miami. In the background are Miami's bayfront hotels. Also shown is the Municipal Auditorium, where the House of Delegates will meet during the Association's annual session November 8-11.

HIGH LIGHTS
AMERICAN DENTAL ASSOCIATION
95TH ANNUAL SESSION

Miami, Florida — November 8-11, 1954

SCIENTIFIC PROGRAM • Opening Monday, November 8, Dinner Key Auditorium

Scientific essays including five symposiums
- Elastic impression materials
- Effects of sugars and other carbohydrates on the teeth
- The dentist's responsibilities in atomic bomb disaster
- Newer devices for cutting tooth structure
- Hazards of roentgenology in dentistry

Thirty-six projected clinics
Motion pictures, table clinics, scientific exhibits

MEETINGS OF THE HOUSE OF DELEGATES • Miami Municipal Auditorium

Monday morning, November 8; Wednesday afternoon, November 10; Thursday morning, November 11.

GENERAL MEETING • Tuesday evening, November 9, Miami Municipal Auditorium

Senator William F. Knowland, speaker

PRESIDENT'S DINNER • Wednesday evening, November 10, Hotel di Lido

needs of dental schools for faculty personnel and to determine the essentiality for deferment of individual faculty members. In addition, the information will help the Council maintain an up-to-date record of the faculty members in the various schools.

DENTISTS INVITED TO MIAMI SELECTIVE SERVICE MEETING

The National Advisory Committee to the Selective Service System is meeting in Miami Beach, Fla., November 11 in the San Marino Hotel. Dentist members of state advisory committees to Selective Service are invited to attend.

The agenda is expected to include a discussion of the needs of the Armed Forces for medical personnel after expiration of the dentist-physician draft law in June.

LEROY ENNIS SERVES AS EGYPT DENTAL ADVISER

LeRoy M. Ennis, former Association president and a member of the Council on International Relations, returned to Cairo at the end of September to serve as dental consultant to the Egyptian government. Dr. Ennis will work on dental programs of the department of health, the armed services and the Cairo dental school. Last year, Dr. Ennis served as adviser to the dental school of Cairo University and supervised a number of major revisions at the school.

OPPORTUNITIES IN DENTISTRY OUTLINED IN BROCHURE

Dentistry as a Professional Career, a brochure addressed to prospective dental students, has been prepared by the Council on Dental Education. The brochure, which has been sent to the deans of dental schools in the United States and Canada, to guidance officers, state dental associations and librarians, outlines the opportunities for a career in dentistry, as well as the skills and education required.

The booklet also contains information on licensure, problems of practice location and income and expense figures. Single copies are available from the Council on Dental Education at the Central Office.

MATERIAL COMPILED ON ANTIFLUORIDATIONISTS

Material on some of the individuals, organizations and publications actively opposing fluoridation has been compiled by the Bureau of Public Information and is available on request from the Bureau.

The material is quoted verbatim from the source listed. Among the individuals described are Charles Betts of Toledo, Ohio, E. H. Bronner of Los Angeles and A. L. Miller, Congressman from Nebraska.

PROTESTS ARTICLE ON ULTRASONIC DRILL

An article stating that a painless, ultrasonic drill is "now generally available to dentists who wish to add it to their equipment" has been protested by the American Dental Association. The article, entitled "New Dental Drill Does Not Hurt," appeared in the October issue of *Better Homes and Gardens* magazine.

Upon inquiry from the Association, Arthur Kuris, president of Cavitron, the firm which manufactures the high speed handpiece, wired that the machines were available only for investigative purposes. "It is not our policy to offer machines for general routine use now," he said. "Regret the omission of this information in the *Better Homes and Gardens* article although it was supplied to them."

Pointing out that the magazine article had encouraged a demand by the public for a device not available for routine den-

tal practice, the Association's Bureau of Public Information requested the magazine editors to correct the misstatement and to inform their readers that the device is in the experimental stage and is not available for use in general dental practice.

SURVEY OF DENTAL PRACTICE ISSUED BY BUREAU

The first analysis of the professional expenses of dentists across the nation made since 1929 is contained in *The 1953 Survey of Dental Practice,* issued in booklet form this month by the Bureau of Economic Research and Statistics. The booklet is a reprint of the series of articles which appeared in THE JOURNAL from December 1953 through August 1954.

"Information derived from this survey will help detect efficient and inefficient characteristics of dental practice," stated B. Duane Moen, Bureau director. The survey analyzes how income varies with such factors as length of patient appointments, personnel employed and office equipment owned. Income is correlated also with the size of the city in which the dentist practices, region of the country, age of the dentist and type of practice.

Single copies of the booklet may be obtained from the Bureau of Economic Research and Statistics at the Central Office of the Association.

DENTISTS ON MEDICAL CARE COMMITTEE FOR INDIGENT

Two representatives of the dental profession, David W. Brock and Robert A. Downs, have been named to a newly organized Joint Committee on Medical Care for the Indigent. The new committee is composed of representatives from five professional health associations, the American Dental Association, American Hospital Association, American Medical Association, American Public Health Association and American Public Welfare Association. The committee's purpose is to coordinate the efforts of the organizations in the field of medical care for the needy and to improve programs at state and local levels.

An informal meeting of staff representatives of the groups was held at Association headquarters in Chicago during September. Dr. Brock and Dr. Downs, Association representatives, are chairman and member respectively of the Council on Dental Health.

COUNCIL PREPARES KIT ON DENTAL CARE PROGRAMS

A kit of materials describing group dental care programs has been prepared by the Council on Dental Health. The kit, which is designed to help dental societies study the various aspects of such programs, contains a bibliography of materials on the subject as well as detailed description of a number of plans currently in operation. Included is information on kinds of services provided, methods of remuneration of dentists, financing and administration.

Copies have been mailed to state society officers, and single copies may be obtained from the Council on Dental Health at the Central Office.

ARMED FORCES ACT TO INSURE SALE OF OLD FILM AS SCRAP

The Council on Dental Trade and Laboratory Relations has been notified that both the Army and Navy have taken steps to insure that outdated dental x-ray film can be purchased only by firms which intend to use it for salvage. Previously, court action had been taken against one New York supply house which was selling the surplus film to dentists as new film suitable for professional use.

Dental Societies

UNION DENTAL PROGRAM UNDER WAY

Some 10,000 children in four Pacific coast ports soon will be eligible for dental care under a welfare fund program of the International Longshoremen and Warehousemen's Union and the Pacific Maritime Association. The program, which was designed with the help of the California, Southern California and Washington State Dental Associations, began in San Francisco October 1 and will be extended shortly to the Los Angeles area, Portland and Seattle.

Designed as a one year pilot program, the dental care plan operates on a $750,000 surplus in the ILWU-PMA Welfare Fund and provides dental care, exclusive of orthodontic treatment, for children of union members up to the age of 15. It is believed that the ILWU-PMA plan is the first dental care program to be established under a union health and welfare fund and the first to provide treatment not for union members—but exclusively for the children of members.

As the California program is designed, members may choose a dentist from a closed panel or may continue with their own dentist under an indemnification scheme administered by an insurance company. Children will be allowed up to $75 this year in care with fees based on the Veterans Administration schedule. In addition, $150 insurance is provided for accidental injury to teeth. Dentists may provide care beyond the $75 limit and may charge more than the VA schedule, subject to agreement with the parents who will assume the additional cost.

In Washington, the executive committee of the Washington State Dental Association approved the incorporation of the Washington State Dental Service Corporation October 2. The corporation will provide dental care on an open panel basis, and its organization is similar to that of medical service bureaus in Washington.

At the same time, the Oregon State Dental Association is attempting to develop a program to meet the request of the ILWU for a dental care program in Oregon.

BUTTE SOCIETY HONORS TWO WHO PRACTICED 50 YEARS

Two dentists who have practiced dentistry for more than 50 years were honored September 20 at a testimonial

At a meeting of the West Virginia State Dental Society, Leslie M. FitzGerald (right), president of the American Dental Association, congratulates James W. Ruble (left), director of the bureau of dental health of the West Virginia Department of Health, and J. Bernard Poindexter, president of the State dental society, on the work they are doing to bring fluoridation to West Virginia communities. The Society met July 25-28 at White Sulphur Springs, W. Va. Today 29 communities, with one fourth of the State population, have fluoridation programs.

The New Jersey State Dental Society held its semi-annual meeting in Jersey City October 12 and 13. Shown at a testimonial dinner given during the meeting for Edward R. White, Fourth District trustee, are (l. to r.): Richard I. Nevin, executive officer, New Jersey State Medical Society, a guest speaker; Dr. White; C. Willard Camalier, Association assistant secretary and a guest speaker, and Charles H. Patton, Third District trustee.

dinner of the Butte (Montana) Dental Society. The men, Alvernus Humphrey Cole and Bernard J. Keenan, began their practice in the early nineteen hundreds, when there were no laboratories or supply houses for many miles and when dentists worked under great handicaps. The men recalled that they soldered bridges by means of a large wick alcohol lamp and mouth blowpipe.

Dr. Cole and Dr. Keenan have been active in the affairs of organized dentistry. They have held every office in the local and state dental societies. Among the speakers at the dinner to honor the two men was C. S. Renouard, 11th District trustee.

Dental Education

CLOSED CIRCUIT TV GIVEN KANSAS CITY SCHOOL

A closed circuit television system which enables more than 100 students seated in a lecture hall to watch an operation taking place in another room was given in September to the University of Kansas City School of Dentistry by the School's alumni association. The Kansas City school is one of the first dental colleges to acquire this type of equipment.

The TV installation uses a newly designed camera weighing only five pounds. The image is projected on a 4 by 5 foot screen. In addition to transmitting the image to the lecture room, the equipment allows the dental instructor who performs the operation to talk to the class during the presentation by means of an audio system. Students in the lecture hall, in turn, may ask questions over a loudspeaker system.

The gift was presented to Dean Roy J. Rinehart by Joseph F. Jacobs, president of the alumni association.

EMORY MEDICAL SCHOOL CELEBRATES CENTENNIAL

Hundreds of physician-alumni of Emory University returned to the campus in Atlanta October 4 and 5 to celebrate the founding of the University's School of Medicine a century ago. Joining them were official delegates from the nation's medical schools and medical societies. Also present were representatives of the dental profession.

Included in the program in addition to the centennial convocation were addresses by leaders in the medical profession, social events and a special medical school centennial issue of the *Emory Alumnus*, which detailed the history of the medical school.

Among those representing the dental profession were A. Raymond Baralt, dean of Loyola University School of Dentistry; John E. Buhler, dean of Emory University School of Dentistry; Gerald A. Mitchell, professor of periodontology, representing the College of Medical Evangelists' School of Medicine, and Harry Lyons, dean of the School of Dentistry, Medical College of Virginia, and speaker of the House of Delegates of the American Dental Association.

NEW BUILDING TO HOUSE WEST VIRGINIA SCHOOL

Construction will soon be under way on the Basic Science Building of the Medical Center of West Virginia University. The new building will provide facilities for some 1,100 students in the health professions, including 240 in the medical school and 200 in the dental school.

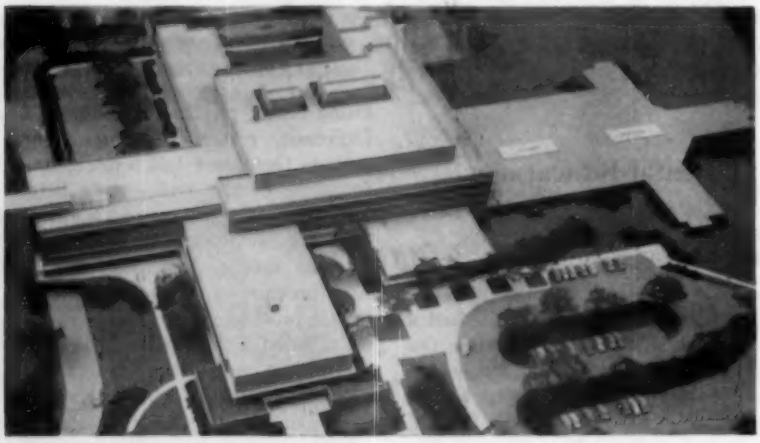
The dental school, which will be located on the first floor of the building, will provide 8 clinics, 2 lecture rooms, 9 clinic demonstration rooms as well as smaller class rooms and a dental supply house. The dental school expects to admit its first class for the 1956-57 school year.

Plans are underway also for a 500 bed hospital scheduled to be ready in 1958.

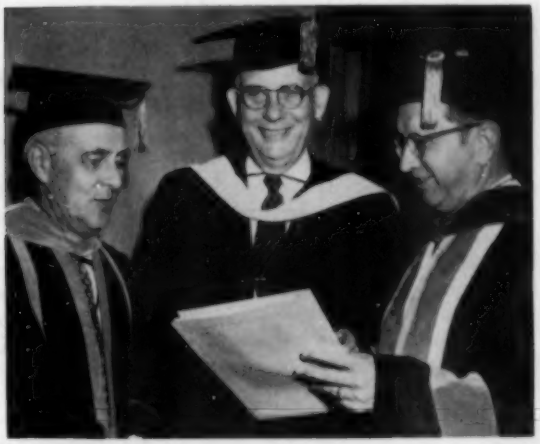
CHILDREN'S HOSPITAL OFFERS DENTAL RESIDENCY

A one year, full-time dental residency beginning July 1 with a yearly stipend of $1,200 plus maintenance is being offered by the Children's Hospital of Philadelphia. The residency provides training in pedodontics, oral surgery, oral medicine and operating room technics. Opportunities are provided also to participate in dental programs associated with the treatment of cerebral palsy and cleft palate patients.

An applicant should be a recent graduate of an approved dental school. Further information may be obtained from Raymond Werther, chief of the dental service, The Children's Hospital of Philadelphia, Philadelphia 46.



The West Virginia University dental school will be housed on the first floor of the new Basic Science Building, on which construction will soon start. To the right on the model is the 500 bed hospital also to be constructed.



Discussing the future of Baylor University dental school at dedication ceremonies in Dallas, Texas, October 4 are (l. to r.): Harry B. McCarthy, dean of the dental school; William R. White, Baylor University president, and Shailer Peterson, secretary of the Council on Dental Education of the American Dental Association.

BAYLOR SCHOOL DEDICATES NEW DENTAL BUILDING

The new basic science wing of Baylor University College of Dentistry in Dallas, Texas, which was dedicated October 4 makes possible an increased enrollment in the dental school, University officials have announced. The $600,000 wing provides additional class rooms and laboratories as well as expanded facilities for research. A school of dental hygiene is scheduled to open in 1955.

Shailer Peterson, secretary of the American Dental Association's Council on Dental Education, and Hollis O. Warrick, Association vice-president, spoke at the dedication ceremonies. Dr. Peterson discussed trends in dental education.

SCHOOLS ANNOUNCE NOVEMBER COURSES, WINTER PROGRAMS

Illinois • A course in interceptive orthodontics in general practice is offered in Chicago by the University of Illinois College of Dentistry for five Wednesdays beginning November 17. Earl W. Renfroe and Thomas K. Barber will present construction of interceptive appliances and will show the use of these appliances for adults and children. Dentists taking the course will construct several interceptive appliances during the laboratory sessions.

Kansas City • The University of Kansas City School of Dentistry in Kansas City has issued its postgraduate winter program. Included in the 13 courses are general anesthesia, pedodontics, oral surgery, cleft palate rehabilitation and practice administration. Classes begin in November, February and March. Further information may be obtained from Joseph F. Jacobs, director of the postgraduate division at the dental school.

New York • A ten session, one evening a week, refresher course in periodontics is offered by the New York University College of Dentistry beginning February 23, 1955. Also offered are a two week full time course and a half-year course in Spanish. The language program begins January 10, 1955.

Philadelphia • Dentistry for handicapped children will be taught March 7-9 at the School of Dentistry of the University of Pennsylvania in Philadelphia. The course will cover the various handicap condi-

tions, their oral manifestations and treatment.

In addition, during November, December and January courses are being given in partial dentures, oral surgery and anesthesia, the use of the bite plane as an adjunct to periodontal therapy, precision prosthesis to restore function and crown and bridge prosthesis.

Temple • Temple University School of Dentistry in Philadelphia announces a course in clinical occlusion January 26-28, 1955. Lewis Fox is instructor. Enrollment is limited to 25. Further information may be obtained from Louis Herman, director of postgraduate studies.

Virginia • Eight postgraduate courses have been scheduled for the 1954-55 school session by the Medical College of Virginia School of Dentistry: crown and bridge prosthesis, November 15-17; oral diagnosis, December 6-11; complete denture construction, January 17-22; partial denture design, January 24-29; periodontics, February 21-25; oral surgery, March 7-9; anatomy of the head and neck, March 14-18, and roentgenology, March 28-30. Further information may be obtained from the school in Richmond.

Washington • A dental refresher course entitled "Procedures in the Use of Amalgam" will be presented November 19-21 at the University of Washington School of Dentistry in Seattle. The lectures and clinical demonstrations will be correlated with a day and a half of clinical work on patients by those taking the course.

In addition, a refresher course in hydrocolloid indirect technic will be taught December 6-8. The class is arranged as follows. All participants will meet for lectures, demonstrations and discussion periods December 6, laboratory sessions for students outside the Seattle area will be held December 7 and laboratory sessions for students from Seattle December 8.

Public Health

FLUORIDATION BEGINS AT FIRST AIR FORCE BASE

Ramey Air Force Base in Puerto Rico became the first Air Force installation to begin fluoridating the water supply when the health measure was inaugurated there September 28. Col. Carlos F. Schuessler, Ramey dentist, was instrumental in obtaining fluoridation for the post.

First steps to get fluoridation underway were taken in two major U.S. cities. In St. Louis, the Board of Aldermen on October 2 voted approval of the procedure 23 to 3, and in New York, the city's health department urged adoption of fluoridation as the "most economical, practical and effective way to improve the dental health of the citizens of New York City." A resolution to effect the recommendation has been introduced in the City Council.

FRANK ORLAND BECOMES DIRECTOR OF ZOLLER CLINIC

Frank J. Orland has been appointed director of the Walter G. Zoller Memorial Dental Clinic, Lowell T. Coggeshall, M.D., dean of the University of Chicago division of biological sciences, announced October 8. Dr. Orland succeeds J. Roy Blayney, who retired in July.

Dr. Orland received his D.D.S. and B.S. degrees from the University of Illinois and his M.S. and Ph.D. from the University of Chicago. He is associate professor of dental surgery in the Zoller Clinic and is associate professor also in the University of Chicago department of microbiology. He is a past president of the Chicago section of the International Association for Dental Research and program chairman for the forthcoming meeting of the IADR to be held in Chicago in March.

Dr. Orland's most recent research has

Philadelphia, the nation's third largest city, began fluoridation September 22. Shown at the reservoir are J. M. Wisan, chief of the city's dental department; A. L. Borish, Philadelphia County Dental Society (backs to camera); LeRoy Ennis, chairman of the committee on fluoridation of water in Philadelphia; Mayor Joseph Clark; water commissioner Samuel S. Baxter; Charles H. Patton, Third District Trustee; Thomas P. Fox, president-elect of the Pennsylvania State Dental Society; Norman Ingraham, M.D., acting health commissioner, and Hugh Robertson, M.D., president of the Philadelphia County Medical Society.

Col. Carlos Schuessler, Ramey Air Force Base dental officer (left), and Wallace E. Garrison (right), chief engineer, watch Brig. Gen. Alfred F. Kalberer, wing commander, as he presses the button which started fluoridation at the installation in Puerto Rico September 28.

been on the possibilities of caries in mice reared under germ-free conditions since birth.

PUBLIC HEALTH DENTIST POST OPEN IN ST. LOUIS

A position as public health dentist whose job is to direct the city dental health program is available in St. Louis, the city department of personnel has announced. The dental director will work under the direction of the health commissioner and will receive a beginning salary of $634.25 a month. Applicant must be eligible for licensure as dentist in Missouri and must have a Master's degree in public health as well as the D.D.S. degree. Further information may be obtained from the St. Louis Department of Personnel, room 235, Municipal Courts Building.

DIVISION STATUS ACCORDED VIRGINIA DENTAL BUREAU

Improved status was accorded the Dental Health Bureau of the Virginia State Health Department at the end of September when the Bureau was upgraded to the position of a division. Under the new setup, D. R. Wallace, director of the division, is directly responsible to the state health commissioner.

The improved status of the division is in line with Association policy and major credit for the change is attributed to the efforts of the Virginia State Dental Association. Virginia now has two dentists serving as members of the state board of health. They are S. D. Kent of Danville and J. J. Stigall, Jr., of Richmond.

Some 25 states have dental health divisions.

National Defense

ARMY ASKS 279 DENTISTS FOR DECEMBER DRAFT

The Army has asked Selective Service to issue a draft call for 279 dentists in December. The call was made necessary because of the drop in voluntary procurement. It had been expected that of the 279 only 100 would be for December induction and 179 would be called for January. Previously, the Air Force had asked for 150 dentists for December. As there are only about 350 nonveteran dental graduates of the 1954 classes who are available to help fill the quota, some Priority III dentists in the mid-30 age group are expected to be called.

LEGION OF MERIT AWARDED DENTAL CORPS MAN

Cmdr. John V. Niiranen, (DC) USN, of the staff of the U. S. Naval Dental School in Bethesda, Md., was awarded the Legion of Merit recently for "outstanding services to the Government of the United States." Commander Niiranen is head of the department of prosthodontics at the Naval Dental School. The citation noted Commander Niiranen's contribution in the "development of a manikin for casualty training which has contributed immeasurably to the training of civilians and service personnel in meeting emergency situations."

Shailer Peterson (center), secretary of the Council on Dental Education, spoke at the U.S. Naval Dental School, Bethesda, Md., September 17 on trends in dental education. Shown with Dr. Peterson are Rear Admiral Ralph W. Taylor (left), commanding officer, and Capt. Benjamin W. Oesterling, head of the professional branch of the Dental Division, Bureau of Medicine and Surgery, Department of the Navy.

NAVY ESTABLISHES MARYLAND DENTAL RESEARCH FACILITY

A dental research facility has been established as a branch of the dental department at the Naval Training Center in Bainbridge, Md., the Navy Department announced late in September. The research center will be under the direction of Capt. Robert P. Irons, (DC) USN, dental officer of the Training Center. Studies will be carried on in biochemistry and bacteriology as related to oral enzymes. The research projects will be supervised by Lt. Gordon Rovelstad (DC) USNR.

International

RECOMMENDATIONS DRAFTED FOR WHO DENTAL PROGRAM

Collection of information on the prevalence of dental diseases, organization and administration of a dental program, training of staff, health education and research are among the aspects of a World Health Organization dental program for which recommendations have been made by a group of consultants appointed by M. G. Candau, director-general of the WHO.

The group met in Geneva, Switzerland, September 20-25 with members of the WHO secretariat. The major dental diseases and facts on their prevalence were presented along with the recommendations for a WHO dental program.

Members of the consultant group were Saiful Anwar, director of the public health service, East Java, Indonesia; H. Berggren, director of the Eastman Institute, Stockholm, Sweden; Philip E. Blackerby, Jr., director of the division of dentistry, W. K. Kellogg Foundation, Battle Creek, Mich.; John W. Knutson, chief dental officer of the U. S. Public Health Service, Washington, D. C.; G. H. Leatherman, secretary-general of the Fédération Dentaire Internationale, London; C. F. Mummery, chief dental officer of the Malayan Medical Service, and J. Stork, honorary treasurer of the Fédération Dentaire Internationale, Netherlands.

ORAL PATHOLOGY INSTITUTE FOUNDED IN BRAZIL

The Brazilian Institute of Oral Pathological Research was founded September 6 in Salvador. Professor José de Oliveira Lima is president of the research organization. Germano Tabacof is secretary.

CANADIAN ASSOCIATION HOLDS ANNUAL MEETING

Delegates to the 1954 annual meeting of the Canadian Dental Association held Sept. 5-8 at St. Andrews-by-the-Sea, New Brunswick, installed P. G. Anderson as president and elected R. R. McIntyre of Calgary, Alberta, president-elect. The delegates also reaffirmed the Association's policy favoring fluoridation, discussed the need for increased teaching facilities and selected Winnipeg as the site for the 1957 annual meeting. Leslie M. FitzGerald, president of the American Dental Association, represented the U. S. organization at the meeting.

ARGENTINES CONDUCT COURSE IN DENTAL CERAMICS

The graduate school of the Asociación Odontológica Argentina recently conducted a course in dental ceramics under the direction of Paul H. J. Simonsen. In this course, clinical work was done on patients, and each student constructed a complete porcelain crown.

Another Argentine dental association, the Circulo Odontológico del Oeste, sponsored a scientific meeting in Buenos Aires during September. The meeting was under the direction of Horacio R. Zavala.

FRENCH DENTAL GROUPS TO MEET DURING DENTAL WEEK

French dental groups will meet in Paris during the Semaine Odontologique March 31 to April 6. During the dental week the various groups will hold general assemblies as well as scientific sessions. Motion pictures produced in France and elsewhere and a scientific exhibit also are planned. Further information may be obtained from Maurice Vincent, secretary general of the Semaine Odontologique, 31, rue Tronchet, Paris.

Research

MELVIN AMLER TO HEAD BETH ISRAEL'S RESEARCH PROGRAM

Melvin Amler has been named director of Beth Israel Hospital's new dental research program, it has been announced. Persons interested in joining the research staff are asked to contact Irving Salman, director of the dental department at the Hospital, Stuyvesant Park East and 17th Street, New York.

THREE NAMED TO NATIONAL ADVISORY RESEARCH COUNCIL

Maurice J. Hickey, associate dean of the Faculty of Medicine of Columbia University, Francis F. Heyroth, M.D., of the University of Cincinnati College of Medicine, and Jack B. Beardwood, former special assistant to Oveta Culp Hobby, secretary of the Department of Health, Education and Welfare, have been appointed to the National Advisory Dental Research Council. The Council advises the Surgeon General on the use of federal funds administered by the National Institute of Dental Research in the form of research grants to nonfederal institutions.

Dr. Hickey heads the division of oral surgery of Columbia's dental school. He is also director of the New York State Board of Oral Surgery, assistant attending surgeon at Presbyterian Hospital and consultant in oral surgery at Kingsbridge Veterans Hospital. He is the author of numerous scientific articles.

Dr. Heyroth, a biochemist, has specialized in protein chemistry, nutrition and the toxicology of substances handled in industry. Mr. Beardwood has been an administrative associate of an architectural firm which specializes in hospital, shopping center, office building and hotel design.

General

DENTAL HYGIENISTS ESTABLISH MEMORIAL FUND

A fund to provide grants to deserving second year students of dental hygiene and known as The Blanche C. Downie Memorial Fund was established by the North Carolina Dental Hygienists Association at a meeting held at the University of North Carolina in Chapel Hill, N.C., October 3. The fund will be administered by the Dental Foundation of North Carolina and the University Student Loan and Scholarship Committee.

The Blanche C. Downie Memorial Fund was established by the North Carolina Dental Hygienists Association October 3. Attending the presentation were (l. to r.): Mrs. Henry O. Lineberger, chairman of the North Carolina Dental Auxiliary Dental Foundation Committee; Miss Emma Mills, president of the North Carolina Dental Hygienists Association, and John C. Brauer, dean of the School of Dentistry, University of North Carolina.

EASTMAN OFFERS THREE OVERSEAS APPOINTMENTS

Three six month appointments in the overseas Eastman clinics have been offered to dentists who complete a year's appointment at the Eastman Dental Dispensary in Rochester, Basil G. Bibby, director, has announced. The first appointment already has been made, and the appointee, Jacob Poznansky, is now in London. Dentists interested in these positions may write to Dr. Bibby at the Rochester Dispensary, Rochester, N. Y.

Also • The national alumni association of the Baltimore College of Dental Surgery will hold its alumni breakfast at the Delano Hotel, Miami Beach, Fla., Tuesday, November 9. . . . November 18 is the date set for the reunion dinner of the Association of Dental Alumni of Columbia University. The dinner will be at the Henry Hudson Hotel in New York. . . . A McCullom articulator and a set of condyles were stolen from the office of B. B. Weldon, Fort Worth, Texas. Information which might lead to their return may be sent Dr. Weldon at the Medical Arts Building in Fort Worth. . . . Dental health cards in Minnesota schools showed that 400,000 pupils received complete dental care during the 1953-54 school year, an increase of 37,590 over the previous year. . . . Appointment of a dentist to the Medical Advisory Committee of the State Department of Social Welfare has been approved in Michigan. Approval came after the State dental society requested representation for dentistry. . . . A committee of dentists from the Florida State Dental Society will screen dental health materials used in Florida's public schools as a result of cooperation secured from the Department of Education. . . . The Eisenhower grandchildren are good dental patients, according to a recent issue of *Good Housekeeping*. Both Anne and David have visited the dentist regularly since their first fluoride treatments at the age of three.

International Correspondence

NEWS FROM GREAT BRITAIN

The September 7th issue of the *British Dental Journal* is a special educational number which contains three original communications provocative in content and, in addition, contains an educational directory listing dental schools and examining bodies in the United Kingdom together with details of higher dental degrees and diplomas.

Professor H. H. Stones sends information about the altered trend in the teaching of dental mechanics and prosthetics during recent years. The course in dental mechanics is concerned with the technical or laboratory processes in the making of dentures and similar removable prosthetic restorations. In most schools instruction in crown and bridge work is not included in this course. The course in dental prosthetics includes the clinical aspects of the construction of dentures.

Under the previous recommendations of the General Medical Council, the time spent at dental mechanics was 2,000 hours, but in the recommendations introduced in 1952 this number was reduced to 800 hours. Previously it was considered important for a student to be proficient in dental mechanics not only on account of the subject itself, but also in order to acquire manual dexterity before starting the course in operative or restorative dentistry. However, the manual dexterity and sensory perception required for the latter subject is of a very different order from that required for dental mechanics, and in any case, with the reduction in the available time to 800 hours, it is now not possible to train a prosthetist to be an expert dental technician.

It used to be a common practice in the teaching of dental mechanics for the student to carry out the various exercises on plaster casts and at this stage of the course not to carry out prosthetic procedures or see patients. This separation of the student from the patient was a weakness for various reasons. Thus, in the design and fitting of clasps in a partial denture, it was difficult for the student to appreciate the problems of construction if he had not the opportunity of seeing the results of his work in the mouth. Now at an early stage—after about three months in the laboratory—it is becoming more usual for the student to carry out the necessary prosthetic procedures for the dentures that he is making. The training is oriented so that eventually he should be in a position to criticize the work done for him by a technician.

After passing the examination in dental mechanics, the student commences clinical studies and during this period, which is the major part of the course, he continues with dental prosthetics. It is becoming the practice in most schools for the dental technicians who are attached to the associated dental hospital to carry out the actual laboratory procedures in the making of dentures while the student undertakes the clinical aspect just as he will when he is qualified. He must be trained so that he can give instructions to the technicians.

THE DENTAL PROFESSION

In an analysis of the age grouping of the dental profession in the United Kingdom, the age groupings of the whole profession were found to be:

Age	Number	Per cent
Over 86	42	
85 to 76	368	2
75 to 66	4,166	28
65 to 56	1,594	11
55 to 46	2,701	18
45 to 36	2,786	19
35 to 26	3,418	22
	15,075	100

This distribution is unhealthy, and there is every reason for thinking that the actual position is even worse than appears, because the estimates and assumptions that have been used are most conservative. It is, however, very clear that the profession today, besides being numerically inadequate, is seriously top heavy age-wise, with 60 per cent in the top half of the normal practicing life and only 40 per cent in the lower half. It means, moreover, that more than one third of all dentists on the Register in 1954 probably will have ceased to practice by 1964—a loss of about 5,000 men while at the present rate of recruitment the replacements during that period will be near 3,000.

RESEARCH

Professor Martin Rushton writes of current news in the research world as follows. Maurice V. Stack, who recently returned to England after holding a Milton Research Fellowship at the Harvard School of Dental Medicine, has received an appointment under the Medical Research Council and will continue his research at the Dental School of the University of Bristol. In addition to dental research workers receiving grants from the Medical Research Council for specific dental projects on a full or part time basis, the Council also employs several others as full time members of its scientific staff on a more continued basis, and at present such appointments also are being held in the universities of London and Birmingham and at one of the atomic energy research establishments.

The Medical Research Council is advised on dental matters by a dental committee. Seven of the 12 members of the committee including the chairman and secretary are dentists, and the remaining five members represent various relevant branches of science such as pathology, bacteriology and biochemistry. Research grants awarded on the recommendation of this committee in support of dental projects are held in many of the principal dental schools as well as several other university departments. Work supported in this way is published in dental and scientific periodicals, except in very special cases when the Council publishes the articles in its Special Report Series. It is understood that a further dental publication in this series is in the press and will be concerned with caries experience during the rationing period of children on diets some of which contained a supplement of sugar and some of which did not. Research on the lactobacillus has been proceeding at Liverpool, Birmingham and London. R. L. Hartles and co-workers of Liverpool published in the *British Dental Journal* a further installment of metabolic studies concerned with the availability of alpha and beta glucosidases and invertase in strains examined. P. M. C. James and G. J. Parfitt contributed a statistical and laboratory study of the relationship of caries experience and salivary lactobacillus counts, confirming the general usefulness of this tool in caries studies in children. Professor Martin Rushton *(British Dental Journal)* discussed a thick, acquired enamel cuticle on the teeth of golden hamsters living on a powdered diet. The cuticle appears similar in many ways to the acquired cuticles of human enamel but is much thicker and is often laminated. It is frequently penetrated and destroyed by organisms of the bacterial plaque. The same cuticle may form on surfaces of dentin protected from abrasion.

The recent announcement that the Royal College of Surgeons has set aside 3,000 square feet in its new buildings for a department of dental science arouses the hope that this will provide an important center for research as well as postgraduate education. Although it is too early to expect any announcement, the extreme shortage in England of research accommodation available for dental purposes and the proximity of other research and teaching units at the College, particularly in the basic sciences, suggest that this may be a fine opportunity to place a dental research organization in an ideal environment.

FLUORIDATION

An investigation of the possible advantages of fluoridation will be undertaken in four different areas in the United Kingdom; Watford, Southern England; Darlington, Yorkshire; Kilmarnock, Scotland, and Anglesey, Wales. These four places have accepted an invitation from the Ministry of Health to participate in such an investigation, and it is expected that the scheme will be in operation next year. In the investigation, the fluoride concentration will be kept to a limit known to be well within the safety margin, and the main points to be decided will be, first, whether or not there is sufficient improvement in the teeth during the investigation to justify an extension of the scheme, and, secondly, if fluoridation should be shown to be advantageous, what would be the best concentration.

The British Dental Association submitted evidence to the Committee of Enquiry set up by the Ministry of Health to investigate the cost of the National Health Service. The evidence is set out in detail in the September 21st issue of the *British Dental Journal* and makes interesting reading.

Gerald H. Leatherman.
D.M.D., F.D.S.R.C.S.

Book Reviews

EXPERIMENTAL OBSERVATIONS ON THE DIET AND ORAL HYGIENE IN RELATION TO DENTAL CARIES

By R. B. Nevin, B.D.S. 15 pages with 7 illustrations. No price listed. Dunedin, New Zealand, Progress Printing Company, Ltd., 1954.

Nevin examines some possible sources of variation which may explain the inconsistencies of results obtained by different investigators studying dietary control and oral hygiene measures as related to the incidence of dental caries.

He elaborates on a refreshingly different hypothesis that "a food that induces good mastication may acquire both a higher buffer capacity and a higher sugar-forming potentiality from thorough incorporation of saliva than a food that stimulates little chewing and salivary flow. . . . The more vigorous the mastication the more of this sugar may penetrate into the crevices between and in the teeth and be trapped there by food/saliva mixture blocking off the narrow space." Accordingly, changes in physical consistency of foods and the order in which they are eaten are of importance.

A preliminary laboratory test of the effectiveness of toothbrushing is described. Although Nevin recognizes that the tests should be more rigid, he states that toothbrushing can probably deal with sugar that has penetrated into and between teeth only if the sugar is in solution, whereas toothbrushing as usually practiced may only serve to force starchy foods containing sugar deeper into spaces.

Dorothea F. Radusch

HISTOLOGY

By Roy O. Greep, Ph.D. 953 pages with 648 illustrations, 46 in color. Index. Price $15. New York, The Blakiston Co., Inc., 1954.

The book is easy to read. The reader is conscious of the large amount of material in most of the chapters. The material is presented without the use of superfluous, meaningless words and is well organized. Instead of combining various items under large divisions as has been the custom, the author has treated many items individually and made each the subject of a chapter. This treatment gives importance to the topic. Some of the subjects treated in this manner are histochemistry, electron microscope findings, the effects of aging, and certain physiological and pathological manifestations. This is an up-to-the-minute text.

The photography is excellent, and the legends are complete and concise. Several illustrations were made by the use of the electron microscope. Drawings and diagrams are effectively used. In the reviewer's opinion, this book is of greater value to the graduate than to the undergraduate student.

J. R. Schumaker

INDIVIDUAL AND COMMUNITY HEALTH

By William W. Stiles, M.D., M.P.H. 492 pages with illustrations. Index. Price $6. New York, Blakiston Co., 1953.

This is another of the many texts on healthful living written in nontechnical language for college students.

The customary chapters on individual health education are included in this text; the author also includes chapters on community health measures such as sewage disposal, treatment of drinking water, food sanitation, environmental and occupational diseases. Among the many excellent tables are some on life expectancy, death rates of major diseases and deaths from accidents.

A brief subchapter is devoted to dental care. This subchapter must have been written a few years ago, since it makes only passing comment on the fluoridation of water as a caries preventive. This is a comprehensive text on general health with a good bibliography.

F. C. Cady

SCIENCE AND MAN'S BEHAVIOR: THE CONTRIBUTION OF PHYLOBIOLOGY

By Trigant Burrow, M.D., Ph.D. 564 pages with 26 illustrations. Index. Appendix. Price $6. New York, Philosophical Library, Inc., 1953.

Trigant Burrow was, indeed, a brilliant man. He was one of the first psychoanalysts in this country. As a pioneer in his field in America, established formulas did not satisfy him.

Psychoanalysis, as originally conceived, reflected a social and intellectual climate in

which individualism in human behavior and a mechanistic interpretation of the biological sciences were emphasized. Dr. Burrow did not agree with this emphasis. To quote from the foreword, which was written by his associate William E. Galt, "Disorders in behavior were for him (Burrow) essentially social or interrelational, and demanded observation and study in their dynamic group setting."

Dr. Burrow's outstanding contribution was the development of the method of group analysis or "phyloanalysis." In his own words, "the chief mission of this present book is to nourish interest and sympathy in the science of human behavior which I have called phylobiology."

In his earlier book, *The Neurosis of Man*, Dr. Burrow speaks of man's conflicts with his brothers. He talks of "the third debacle [man] is already busily promoting." He felt that if wars are to end man must study the behavior of the species of man rather than the behavior of the individual as an isolated organism.

The psychoanalyst who disagrees with Dr. Burrow will still have to give great credit to the man for his searching, penetrating writings. The layman who will take the time and make the effort to read Trigant Burrow will find his hours well spent.

T. C. Levitas

A SPECULATION IN REALITY

By Irving F. Laucks. 154 pages. Index. Price $3.75. New York, Philosophical Library, 1953.

Here is a most unusual book by a well-known chemist. The author speculates on the nature of reality and the soul without resorting wholly either to the mechanistic or to the vitalistic approach. The term soul is used throughout the work to denote what is loosely referred to as consciousness, spirit, ego, psyche and intellect.

The author's first chapters explain how physics uncovered the nucleus and how the nucleus controls chemical reactions. The author discusses also the relation of evolution to chemical reactions, the relation of instincts to chemical reactions and the evolution of the soul. He then discusses phenomena which are less exactly understood but for which there is abundant proof, such as the reality of psychic phenomena. In the concluding chapters he presents speculations on the immortality of the soul and its relationship to the body. His thoughtful approach is certainly more logical than is unthinking reliance on orthodox religion or the narrow and negative speculations of some so-called scientists who are adept at drawing conclusions regarding matter but who are utterly lost when they attempt to relate their material findings to the plan and purpose of life.

Here is no silly attempt to marry blind scriptural belief with purely mechanical scientific procedures as many authors have tried to do. Mr. Laucks' work is an intellectually honest attempt to draw some inferences on the nature of reality, of man and the universe. This he does very well indeed, and his book will be a refreshing experience for those who still have a trust in their own intellectual processes.

Anderson M. Scruggs

MORRIS' HUMAN ANATOMY

By J. Parsons Schaeffer, M.D., Ph.D., Sc.D., D.Litt. Eleventh edition. 1,718 pages with 1,220 illustrations. Index. Price $16. New York, The Blakiston Co., 1953.

This large volume is one of the most readable texts in gross anatomy. Since the advent of the first edition in 1893, this treatise has continually embodied the latest accepted descriptions in the field of anatomy.

The main text, as is true of all anatomical texts, is primarily a descriptive anatomy of the human body, with the usual formal stress placed on topographical, regional anatomy and on systematic anatomy. New and effective illustrations have been added, and many of the chapters have been rewritten and revised.

The 13 explanatory sections with material derived from the sciences of anatomy, histology, embryology and dentistry emphasize the unity of the sciences.

There are a few omissions, a thing which is unavoidable in a treatise of this size. The strength of the text lies in its unified and basic approach to the field of anatomy, in its scholarly presentation and in the excellence of its illustrations.

G. M. Matsumoto

DENTISTERIE OPERATOIRE. TOME 1. DENTISTERIE THERAPEUTIQUE

By A. Marmasse. 516 pages with 273 illustrations. Price not listed. Paris, J. B. Bailliere et Fils, 1953.

A. Marmasse, professor of operative dentistry at Odontotechnic Dental School of Paris, has presented the profession with a well-organized,

compact text which deals with the therapeutic aspects of operative dentistry, including treatment of the pulp. The restorative aspects of operative dentistry are left for another volume.

The author describes the various methods and technics available for this branch of dentistry but tells the reader also which of these methods he himself prefers.

After explaining the anatomy of teeth and root canals, the author discusses particular problems and abnormalities. It was a surprise to find such a lengthy discussion on the use of arsenic, a subject hardly mentioned in modern American textbooks.

One of the most interesting chapters describes Lentulo's technic of the filling of root canals with special broaches. This technic gives excellent results; operative time is reduced to a minimum.

Sterilization of root canals by iontophoresis or with ozone is urged; both are widely used in France. After describing the etiology and histology of the apical infections and granulomas and their healing process, the author states that apical resection should be used only for certain special cases.

It would be impossible to describe all the chapters and to express opinions on them. It is unfortunate that the language barrier will prevent this very fine book from being read more widely in the United States.

Hratch Abrahamian

THE HUMAN MASTICATORY APPARATUS: AN INTRODUCTION TO DENTAL ANTHROPOLOGY

By Meyer Klatsky, D.D.S., and Robert L. Fisher, D.D.S. 246 pages with 85 illustrations. Index. Price $6. Brooklyn, N. Y., Dental Items of Interest Publishing Co., 1953.

The authors have integrated anthropology, in a clear and concise manner, with the anatomy and physiology of the stomatognathic system, as applied to dentistry. Because of the vastness of this subject, and because this book is the first attempt to correlate these two fields, only the major points of interest to the dentist were included. Extensive bibliographies at the end of each chapter are reference sources for more detailed studies.

The authors are on scientific ground through most of the book, although there is a very obvious slant in favor of the importance of function as against heredity and environmental factors. Therefore, there are many statements that lack of function is primarily responsible for most dental diseases such as "malocclusion, caries and periodontal diseases." For example, according to the authors, "These statistics indicate that the incidence of dental caries is inversely proportional to the amount of force exerted by the individual in ordinary mastication and to the degree of development of his masticatory apparatus. Therefore, caries can be prevented by the use of hard, fibrous and resistant food."

No one can deny that lack of function is contributory to dental disease, but to place it as the only, or the foremost factor, can be questioned. The book is well written and well illustrated.

L. E. Kurth

ORAL AND FACIAL DEFORMITY

By C. Kerr McNeil, Ph.D., L.D.S. 127 pages with illustrations. Index. Price $5. New York, Pitman Publishing Corp., 1954.

This book is the author's thesis for the degree of Doctor of Philosophy at the University of Glasgow. It is an important contribution to the art and science of the rehabilitation of oral and facial deformity. The treatise is amply illustrated with case reports and describes the theory, construction and performance of original and ingenious prostheses designed to alleviate physiological, esthetic and phonetic impediments.

In the cleft palate patient, the remnants of the soft palate are capable of simulating movement of a normally functioning soft palate. The most satisfactory type of appliance, the author states, is the two piece rigid-movable prosthesis. An artificial velum is attached by a universal hinge to the denture in such fashion that the velum is free to follow the movements of the soft tissues and allows no escape of air between the two parts of the palate.

He shows that patients with previous difficulty in retention of appliances are successfully treated by fitting special obturators which are mechanically operated by the patient. These obturators pass well into the undercuts of the clefts and produce no pathological changes in the soft tissues.

The author states that in most cases the surgeon should concentrate on obtaining a well functioning soft palate whereas the dental operator should treat the restoration of the hard palate deformity. Successful treatment requires the closest cooperation between plastic surgeon and dental specialist.

James Springer

BOOKS RECEIVED BUT NOT REVIEWED

MASTER'S THESES IN SCIENCE, 1952 • Edited by Barton Bledsoe. 252 pages. $7. Biblio Press, 1129 Vermont Ave., N.W., Washington, D. C., 1954.

THE CAUSES AND TREATMENT OF BACKWARDNESS • By Sir Cyril Burt, D.Sc. 128 pages. $3.75. Philosophical Library, 15 E. 40th St., New York, 1953.

FOOL'S HAVEN • By C. C. Cawley. 210 pages. $2.75. House of Edinboro, 21 Edinboro St., Boston, 1953.

NO TRIP LIKE THIS • By C. C. Cawley. 238 pages. $2.75. House of Edinboro, 21 Edinboro St., Boston, 1951.

THE BOOK OF HEALTH: A MEDICAL ENCYCLOPEDIA FOR EVERYONE • Compiled and edited by Randolph Lee Clark, Jr., M.D. and Russell W. Cumley, Ph.D. 836 pages with 1,400 illustrations. Elsevier Press Inc., 402 Lovett Blvd., Houston, Texas, 1953.

REBIRTH AND DESTINY OF ISRAEL • By David Ben Gurion, Prime Minister, State of Israel. Edited and translated from the Hebrew under the supervision of Mordekhai Nurock, Minister of Israel in Australia. 539 pages. $10. Philosophical Library, 15 E. 40th St., New York, 1954.

NUCLEAR PHYSICS • By W. Heisenberg. 225 pages with 40 illustrations. $4.75. Philosophical Library, 15 E. 40th St., New York, 1953.

X-RAYS IN DENTAL PRACTICE • By G. H. Hepple. 120 pages with 147 illustrations. 25 shillings. Philips Electrical Ltd., Century House, Shaftesbury Ave., London.

HOW TO RAISE YOUR OWN SALARY • By Napoleon Hill, Ph.D. 303 pages. $3.95. Napoleon Hill Associates, 5316 Sheridan Road, Chicago, 1953.

IS YOUR CHILD ALLERGIC? • By Herman Hirschfeld, M.D. 23 pages. 25 cents. Nelson House, 175 E. 96th St., New York, 1954.

YOU AND YOUR ALLERGIC SKIN • By Herman Hirschfeld, M.D. 24 pages. 25 cents. Nelson House, 175 E. 96th St., New York, 1954.

OUR ADVANCING YEARS—AN ESSAY ON MODERN PROBLEMS OF OLD AGE • By Trevor H. Howell. 186 pages with illustrations. $3.50. The Macmillan Company, 60 Fifth Ave., New York, 1953.

FILLING OF TEETH A MATTER OF STATICS: A SHORT TEXTBOOK • By E. Huller, D.D.S. Illustrated. Blumenthal's Printing Press Ltd., Tel-Aviv, Israel, 1953.

A SOURCE-BOOK OF MEDICAL TERMS • By Edmund C. Jaeger, D.Sc. 145 pages with illustrations. $5.50. Charles C Thomas, 301-7 E. Lawrence Ave., Springfield, Ill., 1953.

AN AMERICAN IN EUROPE: THE LIFE OF BENJAMIN THOMPSON, COUNT RUMFORD • By Egon Larsen. 224 pages with illustrations. $4.75. Philosophical Library, Inc., 15 E. 40th St., New York, 1953.

DEL AYER DE NUESTRA PROFESION • By Francisco Veray Marin, D.D.S. 141 pages with illustrations. Imprenta Rodriguez Lugo, Yauco, Puerto Rico, 1953.

SURVEY OF FOOD AND NUTRITION RESEARCH IN THE UNITED STATES OF AMERICA, 1952-1953 • By the Food and Nutrition Board, National Research Council. 372 pages. $1.75. Superintendent of Documents, U. S. Government Printing Office, Washington, D. C., 1954.

NOYES' ORAL HISTOLOGY AND EMBRYOLOGY • Edited and revised by Isaac Schour, D.D.S. Seventh edition. 448 pages with 290 illustrations. $8. Lea & Febiger, Washington Square, Philadelphia, 1953.

DIABETIC CARE IN PICTURES: SIMPLIFIED STATEMENTS WITH ILLUSTRATIONS PREPARED FOR THE USE OF THE PATIENT • By Helen Rosenthal, B.S. and Joseph Rosenthal, M.D. Second edition. 164 pages with 128 illustrations. $3. J. B. Lippincott Company, East Washington Square, Philadelphia, 1953.

THE DAWN OF THE POST-MODERN ERA: DIMENSIONS OF HUMAN LIFE IN THE LAST HALF OF THE TWENTIETH CENTURY • By Elwyn Judson Trueblood. 198 pages. $3.75. Philosophical Library, 15 E. 40th St., New York, 1954.

Current Literature

A COMPLETE CLEFT REHABILITATION PROGRAMME FOR CLEFT LIP AND PALATE CASES

Hamilton Baxter. J. Canad. D. A. 20:79 Feb. 1954.

Approximately one of 750 babies born in Canada is afflicted with cleft lip or cleft palate.

Although surgeons have repaired clefts of the lip and palate for centuries, it is only in comparatively recent years that an integrated and planned program of rehabilitation has been developed. Such a program requires the expert services and cooperation not only of the plastic surgeon but of a group of specialists which includes the pediatrician, geneticist, dentist, otolaryngologist, speech therapist, orthodontist, prosthodontist and psychologist.

If at two months after birth the nutrition and general health of the baby are satisfactory, he will be able to withstand an operation to repair the cleft lip. At the Cleft Palate and Speech Clinic of the Royal Victoria Hospital in Montreal, after the operation the child is fed with a special rubber-tipped syringe to protect the healing lip as much as possible. Antibiotics are given to reduce the danger of infection in the lungs and other organs, and finally the baby is discharged from the hospital two weeks later. In over 500 such operations, there have been no fatalities.

Cleft palates usually are repaired when the child is about two years of age. This period is chosen for the following reasons:

1. The palatal tissues are sufficiently well developed to permit a successful operation in a high percentage of cases and without operative mortality.
2. The child is just beginning to learn how to speak at this time, and poor speech habits have not become firmly established.
3. It is desirable to close the abnormal passage between the mouth and nasal passages at as early an age as possible without running the risk of a poor operative result.

The services of a speech therapist are most important at about four or five years of age. Exercises, which include blowing up balloons, blowing out candles or blowing small boats about in a tank of water, are employed. The interest of the child is stimulated by making the speech therapy lessons into a series of games or play by the use of toys, picture books and other suitable means.

Dentists can help the child with a cleft lip or palate by cooperating in several ways:

1. By examining the teeth of cleft palate children three or four times a year and filling all cavities however small.
2. By avoiding extraction of deciduous teeth if at all possible; if any must be extracted, by inserting some type of space retainer to avoid crowding of permanent teeth.
3. By using worth-while methods of combatting dental caries, such as a well-balanced diet, brushing of teeth after meals, frequent prophylactic treatments and local sodium fluoride applications.
4. By referring a patient with cleft lip or palate, who is not being adequately rehabilitated, to a cleft palate center for advice.

Charles R. Baker

JOURNAL OF DENTAL RESEARCH
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A PHOTOGRAMMETRIC METHOD OF MEASURING THE VOLUME OF FACIAL SWELLINGS

Hilding Björn, Claes Lundqvist and Petter Hjelmstrom, p. 295.

THE EFFECT OF TRYPTOPHANE DEFICIENCY ON THE JAWS OF RATS

L. A. Bavetta, S. Bernick, E. Geiger and W. Bergren, p. 309.

Inhibition of both endochrondral and periosteal bone formation was produced as a result of tryptophan deficiency. Regressive changes were observed at the end of three weeks in both the femur and the alveolar process. In contradistinction to results obtained in animals with dietary kidney damage produced by early choline deficiency, it is possible by dietary supplementation to correct disturbed growth of bone and dental tissue resulting from early tryptophan deficiency. The pathological changes were associated with a reduction of the amount of osteoid tissue as well as with osteoblastic activity.

A striking feature of these experiments was the tremendous amount of alveolar bone destruction which took place as a result of these deficiencies. Concomitant with the bone de-

struction there occurred fragmentation and disappearance of the attachment fibers.

THE INDEPENDENCE OF CARIES EXPERIENCE AND SALIVARY TRYPTOPHANE CONTENT

Maurice V. Stack, p. 316.

The ranges of salivary tryptophan levels in centrifuged saliva from groups of school children, students, hygienists and outpatients were found to be almost identical. A mean value of 23 ± 8 (standard deviation) micrograms per milliliter was calculated for the 145 samples. For each group, the distribution of values was abnormal in that there were comparatively few central values. Caries experience (DMF counts) was determined for the outpatient group and found to be unrelated to the corresponding salivary tryptophan levels, whether or not allowance were made for existing susceptibility or rate of salivary flow.

ENZYMES OF HUMAN SALIVA. I. THE DETERMINATION, DISTRIBUTION AND ORIGIN OF WHOLE SALIVA ENZYMES

Howard H. Chauncey, Fabian Lionetti, Richard A. Winer and Vincent F. Lisanti, p. 321.

Human saliva was analyzed for hydrolytic enzyme systems. Present in whole saliva were acid phosphatase, alkaline phosphatase, total esterases, cholinesterase, lipase, sulfatase, beta-glucuronidase, beta-D-galactosidase, lysozym and hyaluronidase. Parotid saliva, however, contained only six of these enzymes—acid phosphatase, total esterases, cholinesterase, lipase, beta-glucuronidase and lysozym. Inocula of whole saliva incubated in beef brain-heart infusion broth established that the oral flora was capable of elaborating all but sulfatase and lysozym. The range of activity and mean activity of the enzymes were determined for whole and parotid saliva.

PHOSPHATASE IN HUMAN SALIVA: ITS RELATIONSHIP TO CALCULUS AND LACTOBACILLUS COUNTS

Edith Zak Helman and David F. Mitchell, p. 335.

The phosphatase activity and lactobacillus levels of the saliva of 49 senior dental students were determined. The data show the presence of only one phosphatase enzyme in saliva with a maximum pH at 5.5. No significant difference in either of the determinations was found between the two groups. Likewise, no association between the phosphatase level and the lactobacillus counts in these students was found. The function of phosphatase in the saliva is still in question.

THE AMINO ACID REQUIREMENTS OF ORAL ACIDOGENIC MICROORGANISMS ASSOCIATED WITH HUMAN DENTAL CARIES

Samuel Dreizen, Janet J. Mosny, Ellie Jo Gilley and Tom D. Spies, p. 339.

On the basis of previous studies demonstrating specific differences in the vitamin B requirements of various species and strains of oral acidogenic flora, it was postulated that distinctions in nutritional essentials may contribute to the variability of the acidogenic component of the dentobacterial plaque. These studies have now been extended to establish the amino acid requirements of representative species of oral acidogenic microorganisms in pure and mixed cultures. The assays were confined to the biologically active amino acids present in human saliva.

Specific differences in amino acid requirements exist among the four species of oral acidogenic microorganisms most frequently associated with human dental caries. When grown in pure culture in a chemically defined synthetic medium containing all the presently known nutritional essentials, the test strain of oral *Lactobacillus acidophilus* required glutamic acid, valine, serine, cystine, methionine and phenylalanine. The test strain of *Staphylococcus albus* required proline, valine and methionine. In contrast, growth of the oral strains of *Streptococcus salivarius*, glucose-fermenting saccharomyces and the mixed culture of all four organisms was not affected by the deletion of any one of the 19 amino acids studied, provided that the other 18 were included in the test medium.

Each chemical class of amino acids was essential for the three oral acid-producing bacteria in pure culture, whereas no single class was required by the glucose-fermenting saccharomyces, provided that the other five were present in the test medium. In contrast, acid production by the mixed culture of four test organisms was submaximal in the absence of any one of the six chemical classes of amino acids.

The amino acid requirements of the oral *L. acidophilus and Staph. albus* are strain-specific as well as species-specific.

The observations of this study support the hypothesis that differences in nutritional requirements contribute to the variance in the acid-producing microbial spectrum of the dental plaque.

EXPERIMENTAL DENTAL CARIES. II. EFFECT OF DESALIVATION ON DENTAL CARIES AND CASTRATION AND DESALIVATION ON FLUORINE STORAGE IN THE RAT

Joseph C. Muhler and William G. Shafer, p. 346.

Removal of the submaxillary and sublingual glands, along with the greater part of the parotid gland, in the rat results in an increase in dental caries. Desalivation appears to be twice as destructive in its effect on the dentition of the female as on that of the male. Fluorine, at a concentration of 25 μg. per milliliter, effectively inhibits dental caries in desalivated rats to approximately the same degree in both sexes. No noticeable differences are evident in desalivated or control rats receiving the same diet in respect to the storage of fluorine in the femurs.

Desalivation appears to cause a generalized atrophy of the uterus as well as changes in the adrenal cortex of the female animal. The possibility that the changes observed in the uterus are due to a decreased food intake is not fully defined in this study.

STUDY OF THE POSSIBLE RELATIONSHIP OF PERSONALITY VARIABLES TO DENTAL CAVITIES

John H. Manhold and Nathan Rosenberg, p. 357.

Guilford-Martin and Bernreuter personality questionnaires were administered to eight classes of Navy aviation cadets, and a DMF rating was obtained for all 266 subjects. Correlations were computed between the DMF ratings and the 13 personality trait scores derived from the three Guilford-Martin forms. Bernreuter personality trait scores for B_5N and B_6I also were correlated with DMF ratings, since an earlier study by Manhold and Manhold had shown these scores to be significantly related to oral pathology in a small sample of unselected adults.

Significant correlations for the total cadet sample of .12, −.13, and −.12 were found between DMF ratings and Guilford-Martin traits of ascendancy, agreeableness and cooperativeness, respectively. Chance correlations were obtained for the Bernreuter traits previously found significant.

A correlational analysis was performed separately for each of the cadet classes as a check on the generality of the findings. This analysis revealed that the Guilford-Martin trait objectivity also may relate to oral pathological conditions. Thus, individuals with high DMF ratings are characteristically less agreeable, cooperative and objective. These traits lie in the same personality realm, purportedly that of the paranoid syndrome. The results of this study offer some encouragement to the proponents of a psychosomatic basis for oral pathology.

THE EFFECT OF PROPYLTHIOURACIL ON THE DEVELOPMENT OF MOLAR TEETH OF RATS

K. J. Paynter, p. 364.

Since the administration of thiouracil and related compounds has been shown to inhibit thyroid hormone formation, producing much the same effect as surgical thyroidectomy but without the parathyroid disturbances often accompanying surgery, the administration of thiouracil has been found useful for studying the effects of thyroid hormone deficiency on the development of structures such as the teeth, in which calcification plays a prominent role.

In this experiment, litters of rats of the Long-Evans strain received a daily subcutaneous injection of a 0.1 per cent solution of 6-n-propyl-2-thiouracil in 0.9 per cent saline solution from birth to 25 days. Littermate controls received equivalent injections of 0.9 per cent saline solution. Animals were killed in pairs (control and experimental) at 5, 10, 15, 20 and 25 days of age.

One-half the mandible of each specimen was cleaned and a grenz ray picture taken. The rest of the head was sectioned serially and stained with hematoxylin and erythrosin. There was a marked retardation but not cessation of all phases of tooth development in animals receiving the drug. All developmental processes occurred, and in normal sequence, but at a slower rate than normal. There was also a considerable increase in the density of the cancellous bone of the mandible of each experimental animal although the jaws of these animals were smaller than those of the control animals.

ORAL MANIFESTATIONS OF IONIZING RADIATION. II. EFFECT OF 200 KV. X-RAY ON RAT INCISOR TEETH WHEN ADMINISTERED LOCALLY TO THE HEAD IN THE 1,500 R. DOSE RANGE

James A. English, Carl A. Schlack and Friedrich Ellinger, p. 377.

Three groups of rats totaling 398 animals were used in a radiation study designed to determine the effects on tooth development of a large single dose of roentgen rays to the

head. Twenty-one day old white rats were exposed to 1,500 r of 200 kv. filtered x-radiation and compared with untreated littermate controls.

Striking changes were observed in developing incisor teeth of irradiated animals killed 100 days after treatment. It was apparent from gross, roentgenological and histological studies that there was a temporary stoppage of tooth formation due to damage or destruction of the physiologically active odontogenic cells. The differentiation of new tooth-forming cells from the tooth germ permitted second teeth to be formed. In the mandible the newly formed teeth grew laterally to the original teeth, so that it appeared as though the rats had four incisor teeth in the lower jaw.

THE INDIRECT EFFECT OF X-RAY IRRADIATION ON THE DENTAL PULP OF THE DOG

Viktors Kalnins, p. 389.

Circulatory disturbances, increased formation of collagen around blood vessels—sometimes of radiant structure—and fibrous metaplasia of pulp appeared in the roots of teeth when the crowns were exposed to fractionated irradiation (3,000 to 19,000 r in 52 to 79 days, generated by 170 kv.), although the roots were protected by means of lead shields. Since the dose received by the root as secondary radiation was very small—only 0.8 per cent of the dose received by the crown—the lesions in the root may occur as a result of the indirect effect of roentgen rays through the formation of so-called H substances or leukotoxins in the irradiated pulp of the crown.

An unsuccessful attempt was made to produce changes in the pulp of the crown by means of irradiation of the dentin wall only. In this experiment the pulp was protected by platinum shields.

Since the normal odontoblasts were observed in spite of irradiation by doses of more than 6,900 r, it is probable that mature odontoblasts belong to some of the most highly radio-resistant cells of the body.

A reduction of the period of decalcification during histological preparation was obtained by grinding off the outer layer of the tooth wall. This process prevents the formation of artificial vacuoles and edema of the pulp.

MEASUREMENT OF THE ELECTRIC CONDUCTIVITY OF DENTAL CEMENT. I. METHOD AND VALUES FOR DRY SPECIMENS

Lloyd J. Phillips, Richard J. Schnell and Ralph W. Phillips, p. 400.

DENTAL RESTORATIVE MATERIALS: AMALGAMS, ACRYLICS

W. H. Crawford and Jean H. Larson, p. 414.

A NEW INSTRUMENT FOR RECORDING ORAL MUSCLE FORCES: THE PHOTOELECTRIC MYODYNAGRAPH

Herbert I. Margolis and Prem Prakash, p. 425.

FREQUENCY, SIZE, AND BILATERALISM OF CARABELLI'S TUBERCLE

Howard V. Meredith and Ernest H. Hixon, p. 435.

Study was made of the occurrence, size and bilateralism of Carabelli tubercles in 100 physically normal, 9 year old Iowa children of northwest European ancestry. The basic data were controlled observations on dental casts of the lingual surfaces of the mesiolingual cusps of the permanent maxillary first molars.

Eighty-four per cent of the 200 first molars examined showed some amount of supplemental protuberance. Approximately 60 per cent had moderate to large prominences, and 16 per cent lacked any observable accessory elevation.

Thirteen per cent of the subjects exhibited no accessory elevation on one side of the arch and a slight to moderate elevation on the other side. There was an observable difference in the size of the tubercle on the right and left sides of 70 per cent of the subjects.

Deaths

Beebe, Douglas M., Arlington, Va.; Dental School, Northwestern University, 1933; died July 3; aged 47.

Bell, Robert, Spokane, Wash.; Chicago College of Dental Surgery, Loyola University, 1903; died June 30; aged 79.

Benbrook, Charles M., Los Angeles; College of Physicians and Surgeons, San Francisco, 1900; died June 29; aged 82.

Benney, Bernard E., Huntington Park, Calif.; College of Dentistry, University of Southern California, 1932; died April 6; aged 47.

Best, Elmer S., Minneapolis; Chicago College of Dental Surgery, Loyola University, 1906; died July 9; aged 72.

Black, Clarence J., Blacksburg, S. C.; Atlanta Dental College, 1910; died July 1; aged 68.

Blackburn, Frank G., Shelbyville, Ind.; Baltimore College of Dental Surgery, University of Maryland, 1903; died April 23; aged 79.

Bolard, David A., Philadelphia; School of Dentistry, University of Pennsylvania, 1909; died June 22; aged 68.

Brady, Thomas B., Dexter, Iowa; Baltimore College of Dental Surgery, 1903; died April 2; aged 70.

Branch, Ernest E., Barberton, Ohio; Ohio College of Dental Surgery, University of Cincinnati, 1898; died April 6; aged 83.

Brock, Herbert B., Des Moines, Iowa; College of Dentistry, University of Iowa, 1898; died March 8; aged 78.

Burns, Robert J., Buffalo; School of Dentistry, University of Buffalo, 1923; died March 15; aged 57.

Cary, Allan E., Poughkeepsie, N. Y.; School of Dentistry, University of Pennsylvania, 1924; died March 30; aged 52.

Chase, Ellis E., Chicago; died April 13; aged 84.

Cigrand, Elroy F., Aurora, Ill.; Dental School, Northwestern University, 1920; died July 25; aged 59.

Clark, Elmer D., Bonners Ferry, Idaho; Dental School, Marquette University, 1915; died April 21; aged 61.

Cohen, Morris, New York; New York College of Dentistry, 1924; died July 17; aged 51.

Colgan, John G., McCook, Neb.; College of Dentistry, Creighton University, 1921; died July 20; aged 54.

Crawford, Harry M., Dallas, Texas; College of Dentistry, Baylor University, 1929; died May 30; aged 53.

Dills, Joseph L., Camdenton, Mo.; School of Dentistry, Washington University, St. Louis, 1906; died April 4; aged 72.

Douglas, Harry H., Middletown, Ohio; College of Dentistry, Ohio State University, 1918; died July 23; aged 61.

Downing, Paul H., Spokane, Wash.; North Pacific College of Oregon, Portland, 1927; died June 28; aged 61.

Dudley, A. Douglas, Norfolk, Va.; School of Dentistry, Medical College of Virginia, 1915; died April 14; aged 64.

Duffy, Michael A., Scranton, Pa.; School of Dentistry, University of Pennsylvania, 1899; died April 21.

Eckert, David E., Columbus, Ohio; College of Dentistry, Ohio State University, 1932; died June 21.

Erichson, Charles F., Crystal River, Fla.; Boston Dental College, 1896; died May 8; aged 80.

Fennell, Mathias F., Elmira, N. Y.; School of Dentistry, University of Pennsylvania, 1908; died June 28; aged 73.

Ferguson, Russell B., Baton Rouge, La.; School of Dentistry, St. Louis University, 1914; died May 8; aged 62.

Fleming, John H., Detroit; College of Dental Surgery, University of Michigan, 1901; died July 1; aged 81.

Ford, Wendell P., Milton, Mass.; Dental School, Tufts College, 1917; died June 10; aged 57.

Forestner, John J., Springfield, Ill.; School of Dentistry, St. Louis University, 1929; died April 23; aged 50.

Friedman, Albert, Chicago; Chicago College of Dental Surgery, Loyola University, 1919; died July 19; aged 60.

Gants, Samuel L., Providence, R. I.; died June 28; aged 83.

Hamilton, Simeon F., Mount Sterling, Ky.; Ohio College of Dental Surgery, University of Cincinnati, 1905; died June 16; aged 81.

Hanran, Robert J., Cincinnati; Cincinnati College of Dental Surgery, 1898; died April 30; aged 81.

Hansen, Henry E., New York; College of Dentistry, New York University, 1924; died June 22; aged 61.

Harkrider, Asa N., Kilgore, Texas; School of Dentistry, Vanderbilt University, 1908; died June 11; aged 71.

Hirschman, Herman S., Port Richmond, N. Y.; New York College of Dentistry, 1905; died July 15; aged 73.

Hocker, Clarence E., San Antonio, Texas; Kansas City Dental College, 1899; died June 13; aged 75.

Hoffer, Carl W., Nashville, Tenn.; School of Dentistry, Vanderbilt University, 1908; died July 17; aged 71.

Hopkinson, Roy S., Milwaukee; Dental School, Marquette University, 1910; died June 16; aged 68.

Johnson, Clarence W., Anthony, N. M.; College of Dentistry, Drake University, 1913; died June 6; aged 62.

Johnson, William H., Waverly, Ohio; Ohio College of Dental Surgery, University of Cincinnati, 1895; died June 11; aged 83.

Jones, Charles E., Columbia, Tenn.; Dental Department, Meharry Medical College, 1914; died January 20; aged 68.

Kane, Joseph, Dunmore, Pa.; School of Dentistry, Temple University, 1927; died June 22; aged 50.

Kane, Marcus B., Cathedral City, Calif.; Chicago College of Dental Surgery, Loyola University, 1918; died June 11; aged 71.

Katz, Hyman, New York; College of Dental and Oral Surgery, New York, 1917; died July 7; aged 62.

Kay, Louis E., Niagara Falls, N. Y.; School of Dentistry, University of Buffalo, 1914; died March 9.

Kestler, Roy C., Humeston, Iowa; College of Dentistry, Creighton University, 1908; died June 14; aged 71.

Kidder, Eugene H., Waterville, Maine; died May 2; aged 85.

King, Paul M., Oakland, Calif.; College of Dentistry, University of California, 1926; died July 8; aged 51.

Kokot, Edmund A., Chicago; Chicago College of Dental Surgery, Loyola University, 1924; died June 24; aged 52.

Leon, J. Kalman, Steubenville, Ohio; died June 26; aged 68.

Leonard, Frederick W., Columbus, Neb.; College of Dentistry, Creighton University, 1915; died June 7; aged 62.

Libby, George D., Charlotte, N. C.; Dental School, Northwestern University, 1896; died June 18; aged 80.

Ligon, John E., Louisiana, Mo.; School of Dentistry, Washington University, St. Louis, 1909; died May 26; aged 69.

Longcamp, Henry J., Aurora, Ind.; Cincinnati College of Dental Surgery, 1904; died April 15; aged 75.

Luenzmann, Carl A., Chicago; Wisconsin College of Dentistry, Department of Carroll College, 1909; died June 28; aged 67.

Maislen, Arnold K., Hartford, Conn.; College of Dentistry, New York University, 1948; died June 18; aged 29.

Mangelsdorf, Fred A., Albany, N. Y.; School of Dentistry, University of Buffalo, 1919; died July 1; aged 56.

Marshall, John W., Vienna, Va.; Dental Department, University College of Medicine, Richmond, 1896; died June 15; aged 82.

Maser, Henry, Parsons, Kan.; Pennsylvania College of Dental Surgery, Philadelphia, 1884; died May 6; aged 93.

Maxon, Arthur S., Walla Walla, Wash.; College of Dentistry, University of Minnesota, 1931; died May 14; aged 45.

McCarthy, Ira, Fort Collins, Colo.; Colorado College of Dental Surgery, 1904; died May 28; aged 78.

Micklethwait, Louis H., Chicago; Chicago College of Dental Surgery, Loyola University, 1911; died April 20; aged 74.

Miller, Horace E., Sioux City, Iowa; College of Dentistry, University of Iowa, 1919; died February 12; aged 57.

Miller, Vere A., Columbus, Ohio; Department of Dentistry, Starling-Ohio Medical College, 1910; died June 17; aged 67.

Mills, Robert R., Tucson, Ariz.; School of Dentistry, Indiana University, 1929; died July 17; aged 49.

Mogan, Christopher J., San Francisco; College of Dentistry, University of California, 1900; died May 28.

Moon, Travis L., Spokane, Wash.; College of Dentistry, University of Southern California, 1917; died June 20.

Moses, J. Bernard, Jr., Cincinnati; Ohio College of Dental Surgery, University of Cincinnati, 1923; died June 14; aged 54.

Neaf, William C., Brighton, Mass.; College of Dentistry, University of Iowa, 1935; died November 30, 1953; aged 43.

Newbold, Roland A., Los Angeles; College of Dentistry, University of Southern California, 1931; died July 2; aged 52.

Newton, Walter T., Houston, Texas; Texas Dental College, Houston, 1918; died July 9; aged 57.

Nye, Johnson A., Ida Grove, Mo.; College of Dentistry, University of Iowa; 1917; died April 9; aged 59.

Orr, Walker R., Wellington, Texas; died June 4; aged 75.

Parcells, Rue P., Amarillo, Texas; Dental School, Northwestern University, 1914; died May 24; aged 68.

Parks, Robert R., Steelton, Pa.; School of Dentistry, University of Pennsylvania, 1903; died April 27; aged 73.

Plath, Robert E., Spokane, Wash.; Ohio College of Dental Surgery, University of Cincinnati, 1903; died May 29; aged 75.

Pugh, William M., Wichita, Kan.; Kansas City Dental College, 1918; died June 10; aged 64.

Putlitz, Helmuth W., Philadelphia; died June 24; aged 74.

Raklewicz, Joseph A., Scranton, Pa.; Chicago College of Dental Surgery, Loyola University, 1918; died April 7; aged 74.

Richardson, Harold E., Detroit; College of Dental Surgery, University of Michigan, 1924; died June 28; aged 60.

Rixman, Reuben W., Cape Girardeau, Mo.; School of Dentistry, Washington University, St. Louis, 1922; died June 12; aged 54.

Roe, Frederick A., Burlington, Iowa; College of Dentistry, University of Iowa, 1896; died July 4; aged 85.

Ross, Smith C., Vanceburg, Ky.; Ohio College of Dental Surgery, University of Cincinnati, 1916; died July 3; aged 61.

Saylor, Ezra C., Berlin, Pa.; Baltimore College of Dental Surgery, University of Maryland, 1905; died June 9; aged 72.

Scher, Emmanuel, Boston; Dental School, Tufts College, 1914; died December 9, 1953; aged 64.

Schroeder, Raymond H., Jefferson, Wis.; Dental School, Marquette University, 1923; died June 14; aged 54.

Sharp, Edward E., Marshall, Mo.; School of Dentistry, Washington University, St. Louis, 1905; died May 20; aged 71.

Sheppard, Camillus W., Uhrichsville, Ohio; College of Dentistry, Ohio Medical University, 1902; died June 5; aged 85.

Sheridan, Philip H., Dubuque, Iowa; Chicago College of Dental Surgery, Loyola University, 1902; died February 9.

Souter, Alfred V., Shelby, Mich.; College of Dental Surgery, University of Michigan, 1916; died June 23; aged 64.

Stevenson, James E., Brookings, Ore.; Philadelphia Dental College, 1894; died in July; aged 85.

Straussberg, Marcus, Bradley Beach, N. J.; died June 22; aged 80.

Tarber, Paul S., New York; New York College of Dentistry, 1906; died June 26; aged 67.

Totten, Samuel E., Quincy, Mass.; died June 12; aged 81.

Upp, Charles W., Chicago; School of Dentistry, University of Pennsylvania, 1886; died June 24; aged 90.

Urich, John E., Daytona Beach, Fla.; New York College of Dentistry, 1898; died May 5; aged 79.

Volk, Mark H., San Marino, Calif.; School of Dentistry, University of Denver, 1912; died July 8; aged 67.

Wallace, James M., Spartanburg, S. C.; Baltimore College of Dental Surgery, University of Maryland, 1904; died November 26, 1953; aged 70.

Ware, Charles C., Oshkosh, Wis.; Dental School, Marquette University, 1923; died July 2; aged 58.

Weaver, H. Dale, Marshall, Ark.; Western Dental College, Kansas City, 1913; died July 8; aged 69.

Weinstein, Marcy, Philadelphia; School of Dentistry, University of Pennsylvania, 1919; died March 28; aged 60.

Weiss, Raymond O., Minneapolis; College of Dentistry, University of Minnesota, 1914; died April 9; aged 64.

Werkman, Herbert P., Indianapolis; Indiana Dental College, 1922; died June 20; aged 53.

West, Nathan M., Lakewood, Ohio; Ohio College of Dental Surgery, University of Cincinnati, 1903; died May 11; aged 72.

Wilds, R. Hartwell, Landrum, S. C.; Atlanta Dental College, 1906; died June 28; aged 76.

Wilkerson, George E., Baltimore; Baltimore College of Dental Surgery, University of Maryland, 1930; died January 17.

Wilson, Newell K., Oakland, Calif.; College of Dentistry, University of California, 1911; died May 25; aged 88.

Wimberly, Alonzo J., Sweetwater, Texas; Atlanta Dental College, 1907; died April 14; aged 67.

Wintersteen, Ross W., Lincoln, Neb.; Lincoln Dental College of Cotner University, 1908; died May 15; aged 78.

Wolf, Peter F., Brooklyn; died July 12; aged 75.

Wooten, Amos M., Jr., Portsmouth, Va.; Atlanta-Southern Dental College, 1940; died June 13; aged 40.

Wright, John S., Wichita, Kan.; Kansas City Dental College, 1909; died June 5; aged 71.

Yale, Edwin L., Temple City, Calif.; Department of Dental Surgery, Detroit College of Medicine, 1905; died February 3, 1953.

Yarbrough, Sidney H., Columbus, Ga.; Atlanta-Southern Dental College, 1932; died June 11.

Zabriskie, Angelo, Ridgewood, N. J.; Baltimore College of Dental Surgery, 1907; died July 18; aged 68.

Zikel, Joseph M., New Haven, Conn.; Ohio College of Dental Surgery, University of Cincinnati, 1920; died April 28; aged 62.

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Announcements

MEETINGS OF THE AMERICAN DENTAL ASSOCIATION

Ninety-Fifth Annual Session	Nov. 8-11, 1954	Miami, Fla.
Ninety-Sixth Annual Session	Oct. 17-20, 1955	San Francisco
Ninety-Seventh Annual Session	Oct. 1-4, 1956	Atlantic City, N.J.

MEETINGS OF CONSTITUENT SOCIETIES

State	Date	Place	Secretary	Address
Alabama	Apr. 4, 5, 1955	Birmingham	F. A. Finney, Jr.	1045 Forrest Ave., Gadsden
Alaska			C. J. Pearson	500 K St., Anchorage
Arizona	Apr. 27-30, 1955	Grand Canyon	R. W. Christensen	17 E. Weldon Ave., Phoenix
Arkansas	Apr. 3-6, 1955	Little Rock	D. M. Hamm	Box 89, Clarksville
California	Apr. 16, 1955	San Francisco	L. R. Ludwigsen	450 Sutter St., San Francisco
S. California	May 9-11, 1955	Los Angeles	J. P. Bowers	124 W. Lime Ave., Monrovia
Colorado	Oct. 2-5, 1955	Colorado Springs	W. R. Humphrey	724 Republic Bldg., Denver
Connecticut	May 18-20, 1955	Hartford	R. S. Arnold	37 Linnard Rd., W. Hartford
Delaware	Jan. 12, 1955	Wilmington	R. J. Zurkow	152 S. State St., Dover
District of Columbia			Z. B. Lloyd	2007 R St., N.W., Washington
Florida	Apr. 24-27, 1955	Jacksonville	J. E. Edwards	152 Alhambra Circle, Coral Gables
Georgia	Oct. 2-5, 1955	Atlanta	J. W. Yarbrough	Bibb Bldg., Macon
Hawaii	June 15-18, 1955	Honolulu	J. H. Dawe	810 N. Vineyard St., Honolulu
Idaho	May 19-21, 1955	Coeur d'Alene	F. O'Halloran	Box 703, Coeur d'Alene
Illinois	May 9-12, 1955	Peoria	P. W. Clopper	623 Jefferson Bldg., Peoria
Indiana	May 16-18, 1955	Indianapolis	D. C. Barnhill	400 Bankers Trust Bldg., Indianapolis
Iowa	May 1-4, 1955	Des Moines	H. I. Wilson	639 Insurance Exchange Bldg., Des Moines
Kansas	May 15-18, 1955	Kansas City, Mo.	F. A. Richmond	861 Brotherhood Bldg., Kansas City
Kentucky	Apr. 18-21, 1955	Louisville	A. B. Coxwell, Jr.	1976 Douglass Blvd., Louisville
Louisiana	Apr. 13-16, 1955	New Orleans	J. S. Bernhard	2515 Line Ave., Shreveport
Maine	June 23-25, 1955	Rockland	S. M. Gower	Box 27, Skowhegan
Maryland	May 2-4, 1955	Baltimore	E. L. Pessagno, Jr.	415 Medical Arts Bldg., Baltimore
Massachusetts	May 1-4, 1955	Boston	H. E. Tinsley	12 Bay State Rd., Boston
Michigan	Apr. 18-20, 1955	Detroit	F. Wertheimer	Michigan Dept. of Health, Lansing
Minnesota	Mar. 28-30, 1955	Minneapolis	C. V. E. Cassel	225 Hamm Bldg., St. Paul
Mississippi	Apr. 24-27, 1955	Jackson	B. A. Cohen	306 Plaza Bldg., Jackson
Missouri	May 15-18, 1955	Kansas City	E. D. Sugget	201 Merchants Bank Bldg., Jefferson City
Montana	May 5-7, 1955	Bozeman	E. G. Vedova	Roundup
Nebraska	May 9-12, 1955	Lincoln	F. A. Pierson	1112 Federal Securities Bldg., Lincoln
Nevada	June 17-19, 1955	Lake Tahoe	O. M. Seifert	506 Humboldt St., Reno
New Hampshire	June 12-14, 1955	Whitefield	F. E. Williams	814 Elm St., Manchester
New Jersey	Apr. 18-20, 1955	Atlantic City	J. G. Carr	407 Cooper St., Camden
New Mexico	May 22-25, 1955	Ruidosa	J. S. Ellar	Medical Arts Square, Albuquerque
New York	May 16-18, 1955	New York	C. A. Wilkie	1 Hanson Place, Brooklyn
North Carolina	May 15-18, 1955	Pinehurst	R. D. Coffey	Kibler Bldg., Morganton
North Dakota	May 1-4, 1955	Grand Forks	V. B. Keltgen	517 de Lendrecie Bldg., Fargo
Ohio	Nov. 13-16, 1955	Cleveland	E. G. Jones	185 E. State St., Columbus
Oklahoma	Apr. 20, 1955	Tulsa	S. A. Russman	809 Medical Arts Bldg., Oklahoma City
Oregon	Mar. 7-9, 1955	Portland	T. D. Holder	308 Selling Bldg., Portland
Panama Canal Zone			A. L. Teitel	Box D, U.S. Naval Station, Rodman
Pennsylvania	May 16-18, 1955	Philadelphia	M. D. Zimmerman	217 State St., Harrisburg
Puerto Rico	Jan. 26-29, 1955	San Juan		Box 624, San Juan
Rhode Island	Jan. 1955	Providence	B. C. Friedman	2 Ayrault St., Newport
South Carolina	May 22-24, 1955	Charleston	J. R. Owings	7 Medical Court, Greenville

State	Date	Place	Secretary	Address
South Dakota	May 15-17, 1955	Aberdeen	L. N. Thelen	310A W. 18th St., Sioux Falls
Tennessee	May 8-12, 1955	Nashville	A. M. Ballentine	Pulaski
Texas	May 1-5, 1955	San Antonio	W. Ogle	3607 Gaston Ave., Dallas
Utah	Apr. 21-23, 1955	Ogden	R. C. Daigleish	124 State Capitol Bldg., Salt Lake City
Vermont	May 30-June 1, 1955	Manchester	W. J. Reardon	18 Madison St., Rutland
Virginia	Apr. 29-May 6, 1955	Havana, Cuba	W. T. McAfee	705 Colonial National Bank Bldg., Roanoke
Washington	Mar. 24-26, 1955	Seattle	W. B. Martin	Medical-Dental Bldg., Seattle
West Virginia	July 24-27, 1955	White Sulphur Springs	G. N. Casto, Jr.	710½ Lee St., Charleston
Wisconsin	Apr. 25-27, 1955	Milwaukee	A. E. Kopp	Wells Bldg., Milwaukee
Wyoming	June 16-18, 1955	Cheyenne	T. J. Drew	State Office Bldg., Cheyenne

MEETINGS OF STATE BOARDS OF DENTAL EXAMINERS

State	Date	Place	Secretary	Address
Alabama	June 20-24, 1955*	Birmingham	W. L. McCarty	200 Professional Center, Montgomery
	June 20, 21, 1955†			
Alaska			R. H. Williams	Box 2122, Juneau
Arizona			R. K. Trueblood	107 East A Ave., Glendale
Arkansas	June 20-24, 1955*†	Little Rock	H. O. Weatherly	205 Halter Bldg., Conway
California			T. E. Tilden	Medico-Dental Bldg., Sacramento
Colorado			J. M. Peabody	724 Republic Bldg., Denver
Connecticut	Dec. 5-11*†	New York	C. G. Brooks	302 State St., New London
		Bridgeport		
Delaware			P. K. Musselman	143 W. Main St., Newark
District of Columbia			W. T. Birthright	Suite 718, 1835 Eye St., N.W., Washington
Florida	July 11-21, 1955*†	Jacksonville	A. W. Kellner	P. O. Box 155, Hollywood
Georgia			P. M. McNeil	307 First National Bank Bldg., Rome
Hawaii			H. L. Houvener	427 Dillingham Bldg., Honolulu
Idaho			R. E. Blickenstaff	1023 Fourth St., S., Nampa
Illinois			W. A. McKee	503 Wood Bldg., Benton
Indiana	Dec. 6-9	Indianapolis	C. A. Frech	504 Broadway, Gary
Iowa	May 23-27, 1955‡		D. J. FitzGerald	615 Brick & Tile Bldg., Mason City
Kansas	Jan. 24-27, 1955*	Kansas City, Mo.	G. L. Teall	Box 71, Hiawatha
	Jan. 25, 26, 1955†			
Kentucky			R. M. Justice	1330 Central Ave., Ashland
Louisiana			R. C. Steib	833 Maison Blanche Bldg., New Orleans
Maine			R. A. Derbyshire	Box 387, Skowhegan
Maryland	Nov. 29-Dec. 1‡		H. Levin	3429 Park Heights Ave., Baltimore
Massachusetts	June 13-16, 1955*‡		G. J. Fink	Rm. 33, State House, Boston
	June 15, 16, 1955†‡			
Michigan	Jan. 23-29, 1955	Ann Arbor	J. L. Champagne	3714 W. McNichols Rd., Detroit
	June 5-11, 1955			
Minnesota	Jan. 10-14, 1955*†‡		M. G. Walls	615 Montcalm Place, St. Paul
	June 13-17, 1955*†‡			
Mississippi	Jan. 4-6, 1955	Jackson	J. C. Boswell	508 Lamar Life Bldg., Jackson
	June 21-23, 1955			
Missouri			R. R. Rhoades	414 Central Trust Bldg., Jefferson City
Montana			V. J. Quinn	301 Phoenix Bldg., Butte
Nebraska			H. E. Weber	1210 Federal Securities Bldg., Lincoln
Nevada	Dec. 6	Las Vegas	R. Whitehead	Suite 6, Masonic Temple, Reno
New Hampshire	Dec. 12*	Concord	S. G. Markos	8 Renaud Ave., Dover
New Jersey	Nov. 29, 30*	Philadelphia	W. A. Wilson	150 E. State St., Trenton
	Dec. 1, 2*	Trenton		
	Nov. 29, 30†	Philadelphia		
New Mexico			J. J. Clarke, Sr.	Artesia
New York	Feb. 10, 11, 1955*‡		D. W. Beier	23 S. Pearl St., Albany
	Feb. 15-18, 1955*‡			
	Feb. 10, 1955†‡			
	Feb. 15, 16, 1955†‡			
North Carolina			F. O. Alford	1109 Liberty Life Bldg., Charlotte
North Dakota	June 20-24, 1955	Fargo	A. L. Pushor	Lisbon
Ohio			H. B. Smith	322 E. State St., Columbus

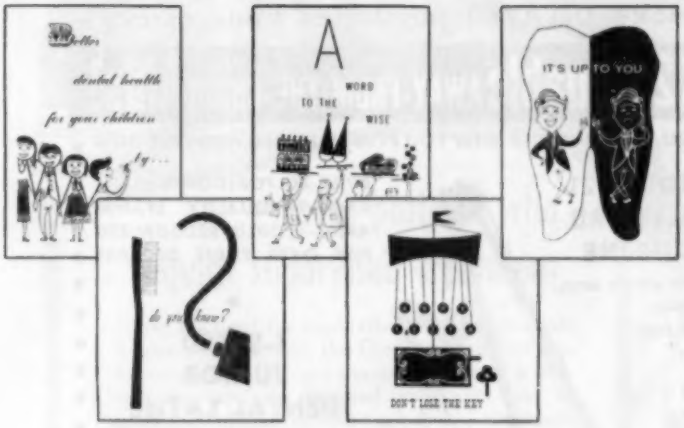
State	Date	Place	Secretary	Address
Oklahoma			R. P. Keidel	403 Surety Bldg., Muskogee
Oregon	Dec. 16-18*†	Portland	F. L. Utter	506 Pioneer Trust Bldg., Salem
Pennsylvania	Dec. 6-11 Dec. 6-8 June 20-25, 1955 June 20-22, 1955	Philadelphia Pittsburgh Philadelphia Pittsburgh	A. M. Stinson	Dept. of Public Instruction, Box 911, Harrisburg
Puerto Rico			J. Mercado C.	Box 3717, Santurce
Rhode Island			F. M. Hackett	267 Academy Ave., Providence
South Carolina	Jan. 27-29, 1955	Columbia	T. C. Sparks	1315 Pickens St., Columbia
South Dakota	Jan. 9-12, 1955	Sioux Falls	H. T. Aker	Canton
Tennessee			C. R. Aita	619 Bennie Dillon Bldg., Nashville
Texas			R. T. Weber	312 Capital National Bank Bldg., Austin
Utah			D. L. Folsom	1101 First Security Bank Bldg., Salt Lake City
Vermont			P. M. Fitch	Newport
Virginia	June 6-11, 1955* June 6, 7, 1955†	Richmond	J. M. Hughes	715 Medical Arts Bldg., Richmond
Washington			M. L. Mower	National Bank of Commerce Bldg., Olympia
West Virginia			C. A. Laughlin	613 Prunty Bldg., Clarksburg
Wisconsin			S. F. Donovan	Tomah
Wyoming			W. A. Hocker	212 O & S Bldg., Casper

Most states require applications to be in 30 days prior to examination date.
*Dental examination. †Dental hygiene examination. ‡Write to secretary of dental examining board for information on locations of examinations. §Approximate dates—verify with state dental examining board.

MEETINGS OF OTHER ORGANIZATIONS

Name	Date	Place	Secy. or Chm.	Address
American Academy of Dental Medicine	Dec. 5	New York	W. M. Greenhut Secy.	124 E. 84th St., New York
American Academy of Gold Foil Operators	Nov. 6	Miami, Fla.	G. D. Stibbs Secy.	School of Dentistry, University of Washington, Seattle
American Academy of the History of Dentistry	Nov. 5	Miami, Fla.	H. L. Faggart Secy.	2120 Pine St., Philadelphia
American Academy of Implant Dentures	Nov. 6, 7	Miami, Fla.	E. J. Kresse Secy.	312 17th St., Denver
American Academy of Oral Roentgenology	Nov. 6	Miami, Fla.	E. A. Bourassa Secy.	1033 Medical and Dental Bldg., Seattle
American Academy of Pedodontics	Nov. 3-5	Miami, Fla.	R. M. Erwin, Jr. Secy.	911 Selling Bldg., Portland, Ore.
American Academy of Periodontology	Nov. 4-6	Miami Beach, Fla.	C. E. Chamberlain Secy.	115 North St., Peoria, Ill.
American Academy of Restorative Dentistry	Feb. 5, 6, 1955	Chicago	A. G. James Secy.	409 N. Camden Drive, Beverly Hills, Calif.
American Association for the Advancement of Science, Section on Dentistry	Dec. 28	Berkeley, Calif.	R. W. Bunting Secy.	2224 Vinewood Blvd., Ann Arbor, Mich.
American Association of Dental Editors	Nov. 6	Miami, Fla.	L. F. Bumgardner Secy.	4-H Doctors Bldg., Charlotte, N.C.
American Association of Dental Examiners	Nov. 5, 6	Miami, Fla.	C. A. Bumstead Secy.	924 Stuart Bldg., Lincoln, Neb.
American Association of Dental Schools	Mar. 21-23, 1955	Chicago	M. W. McCrea Secy.	Baltimore College of Dental Surgery, University of Maryland, Baltimore
American Association of Endodontists	Feb. 5, 6, 1955	Chicago	V. B. Milas Secy.	2559 W. 63rd St., Chicago
American Board of Dental Public Health	Nov. 4, 5	Miami, Fla.	P. E. Blackerby, Jr. Secy.	250 Champion St., Battle Creek, Mich.
American College of Dentists	Nov. 7	Miami, Fla.	O. W. Brandhorst Secy.	4221 Lindell Blvd., St. Louis
American Dental Assistants Association	Nov. 8-11	Miami, Fla.	M. L. Martin Exec. Secy.	410 First National Bank Bldg., LaPorte, Ind.

Name	Date	Place	Secy. or Chm.	Address
American Dental Hygienists' Association	Nov. 8-11	Miami, Fla.	M. Swanson Exec. Secy.	1735 Eye St., N.W., Washington, D.C.
American Dental Society of Anesthesiology	Nov. 6, 7	Miami, Fla.	J. H. Mervis Secy.	510 Walnut St., Clairton, Pa.
American Denture Society	Nov. 5, 6	Miami Beach, Fla.	A. L. Roberts Secy.	Aurora National Bank Bldg., Aurora, Ill.
American Institute of Dental Medicine	Oct. 31-Nov. 4	Palm Springs, Calif.	M. G. Lewis Exec. Secy.	2240 Channing Way, Berkeley, Calif.
American Society of Oral Surgeons	Nov. 3-6	Hollywood, Fla.	R. F. Whalen Exec. Secy.	1112 E. Clay St., Richmond, Va.
Association of American Women Dentists	Nov. 8	Miami, Fla.	M. C. DeRisi Secy.	2800 Woodley Rd., N.W., Washington, D.C.
Chicago Dental Society	Feb. 6-9, 1955	Chicago	K. S. Richardson Exec. Secy.	30 N. Michigan Ave., Chicago
Council on Dental Education, Dental Aptitude Tests	Jan. 14, 15, 1955		S. Peterson Secy.	222 E. Superior St., Chicago
Denver Dental Association Midwinter Meeting	Jan. 9-12, 1955	Denver	B. Kletzky Secy.	724 Republic Bldg., Denver
Detroit District Dental Society, Thirteenth Annual Postgraduate Dental Review	Nov. 22, 23	Detroit	A. C. Pringle Chm.	1111 Kales Bldg., Detroit
District of Columbia Postgraduate Clinic	Mar. 13-16, 1955	Washington, D.C.	E. M. Colvin, Jr. Gen. Chm.	1726 21st St., N.W., Washington, D.C.
Federation Dentaire Internationale	Aug. 14-20, 1955	Copenhagen, Denmark	G. H. Leatherman Secy. Gen.	35 Devonshire Place, London, England
Fourth National Dental Congress of Peru	Nov. 14-20	Lima, Peru	V. R. Iparraguirre Secy. Gen.	Plaza San Martin 981, Lima, Peru
Greater New York Dental Meeting	Dec. 6-10	New York	M. Purdy Exec. Secy.	Rm. 106A, Hotel Statler, New York
Greater Philadelphia Annual Meeting	Feb. 2-5, 1955	Philadelphia	R. Adams Secy.	337 Bellevue-Stratford Hotel, Broad and Walnut Sts., Philadelphia
Journees Dentaires de Paris	Nov. 24-28	Paris, France	J. Ouvrard Secy. Gen.	33, Av. Pierre, 1er, De-Serbie, Paris
Mid-Continent Dental Congress	Nov. 28-Dec. 1	St. Louis	J. E. Brophy Exec. Secy.	8013 Maryland Ave., St. Louis
National Board of Dental Examiners	Dec. 6, 7		G. J. Casey Secy.	222 E. Superior St., Chicago
Southern Society of Orthodontists	Oct. 31-Nov. 3	Washington, D.C.	M. D. Edwards Secy.	132 Adams Ave., Montgomery, Ala.



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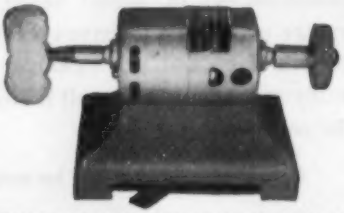

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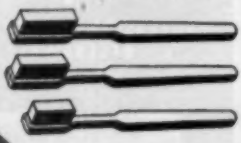

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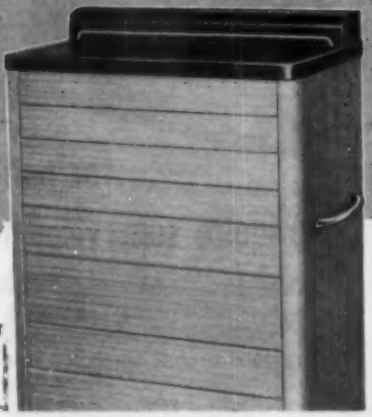

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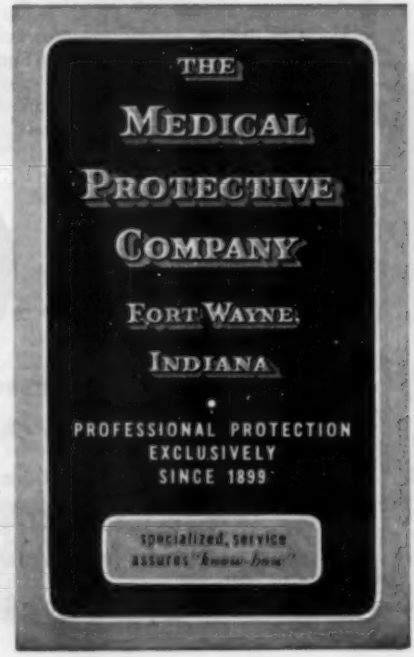

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$200.00	3,000.00	10,000.00	30.15	34.65	43.65	50.65
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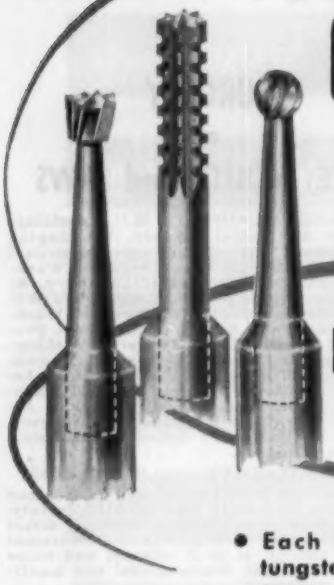

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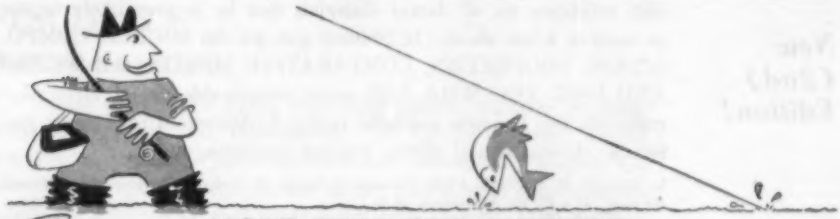

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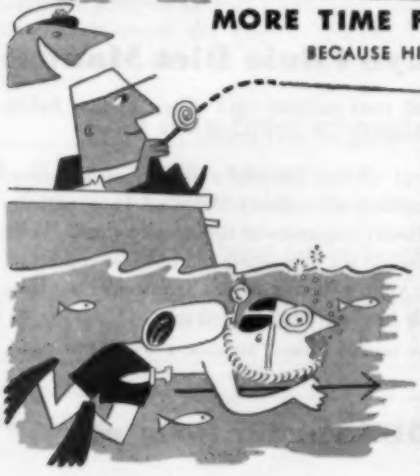

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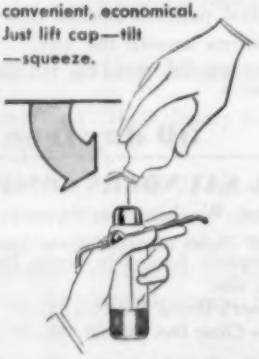

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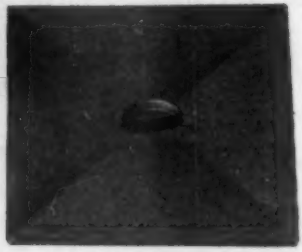

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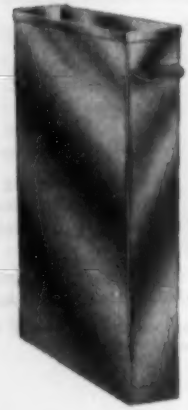

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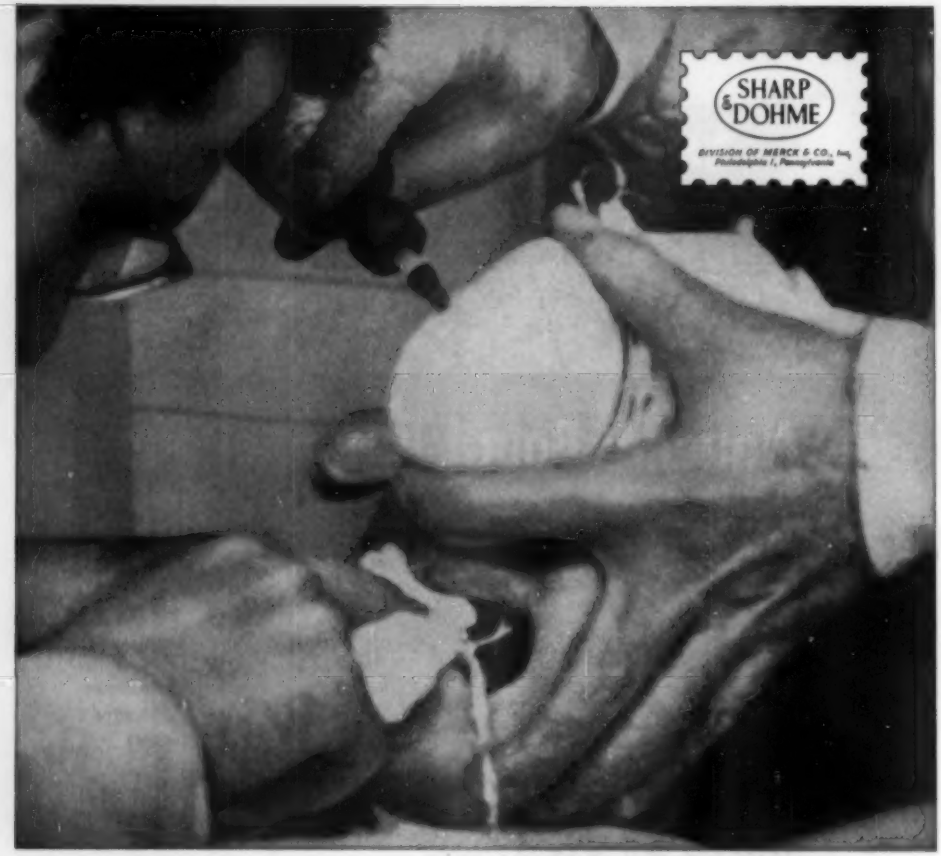

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And some wad eat that want it
But we hae teeth and we can eat
And so the Lord we thankit.

Lots of people appreciate the wonderful contribution to their welfare and happiness which modern dentistry has made possible. The dentist and the chemist have worked together to produce the perfection illustrated in the following pages. Some Oral Pathologists say these dentures are as natural as Nature itself. The story of why the All Luxene Denture excels is well worth reading.

Luxene 44

Luxene 44 denture material was developed by Bakelite Corporation in collaboration with Carbide and Carbon Chemicals Corporation and Luxene, Inc.

Luxene 44 is not an acrylic resin. It is a vinyl co-polymer mixture plasticized with methyl methacrylate monomer and it possesses a combination of essential properties that have raised the standard of denture material values near the goal of perfection. It has been "built" by the world's foremost resin chemists specifically for dentures and it has no other commercial value.

However, it is one thing to produce a material which contains the essential properties of an ideal denture material but it is quite another thing to see that dentures made of this material are processed accurately and properly so that the valuable properties so painstakingly "built" into the product are not thrown away by careless or incompetent technicians.

To safeguard against this possibility, a precision technic has been developed which is known as the "Pressure Cast" process, and details of this process are covered in the following pages. Selected laboratories, which are competent and reliable, are equipped and trained to use the "Pressure Cast" process and they are capable of producing restorations in Luxene 44 to a standard of perfection, the highest anywhere known.

When Luxene-vinyl teeth are selected for use with Luxene 44 denture material, an even more serviceable and practical denture results because Luxene teeth do not crack or craze. The teeth are exceedingly tough and very rarely break, even if the denture is dropped on a tile floor. Luxene teeth also have superior wear resistance, extensive clinical tests over a period of several years has established this fact. The illustration used here is known as the All Luxene C-Tone denture. The C-Tone effect is created by laminating thin sheets of Luxene 44 with proper concentration of blue and red fibres. Oral pathologists say this effect simulates nature.

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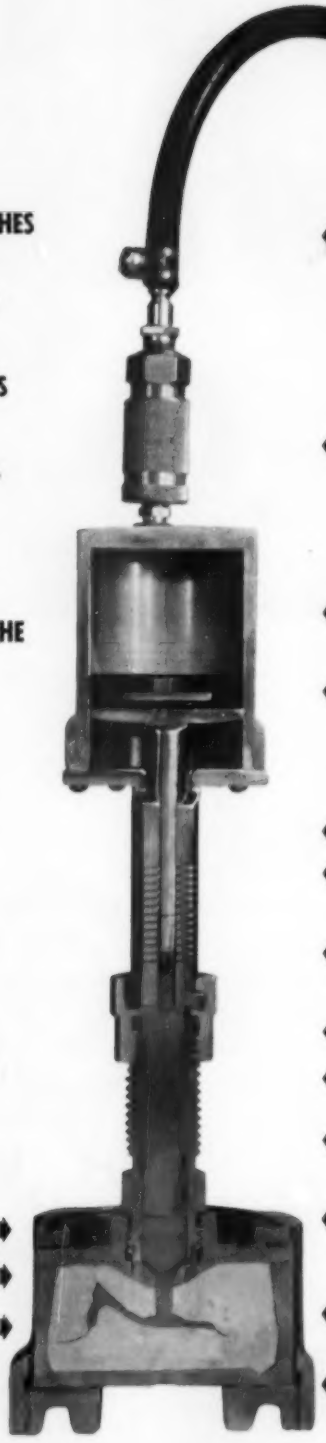

Hose to compressed air supply.

Air gun coupler permits an easy connection to air supply.

Air gun cylinder.

Air gun cup.

Air gun piston.

Air gun guide indicates amount injected.

Hole in piston enables operator to remove the piston by slipping metal rod through the hole and pulling it up. This is necessary for recharging.

Air gun adapter.

Piston.

Nozzle threaded to screw into air gun adapter.

Sprue button.

In the center of the flask is a cross-section of the moulded denture having no fin.

Bottom ring of the "cage" which, when tightened in cage closer, closes the flask perfectly.

Lid and bottom surface perfectly flat so as to close uniformly.

Side of cage.

Flask splits here. Notice how perfectly closed — metal to metal contact.

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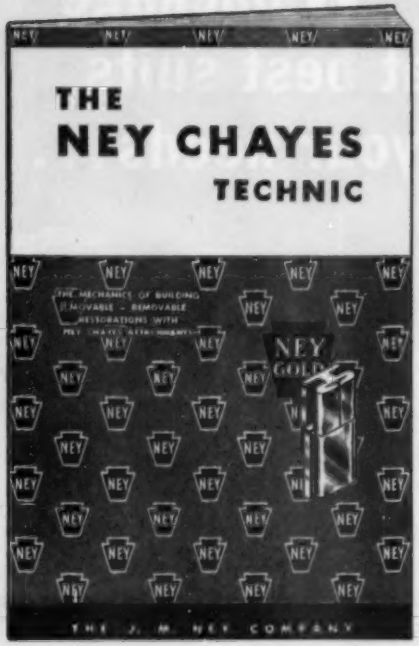

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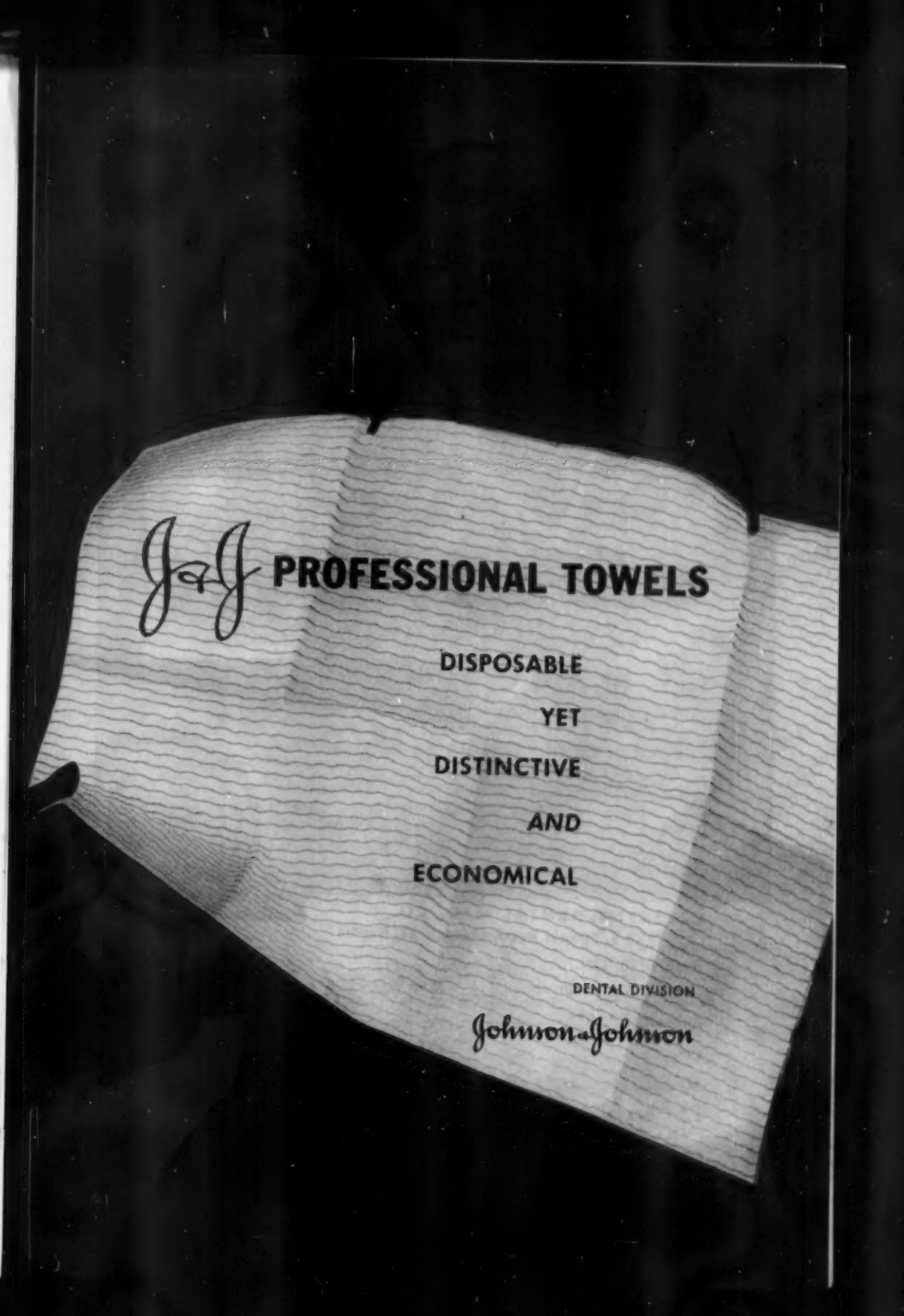
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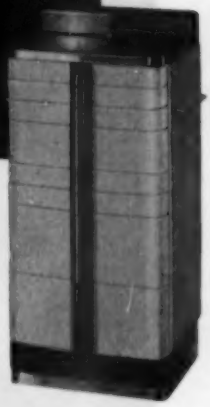

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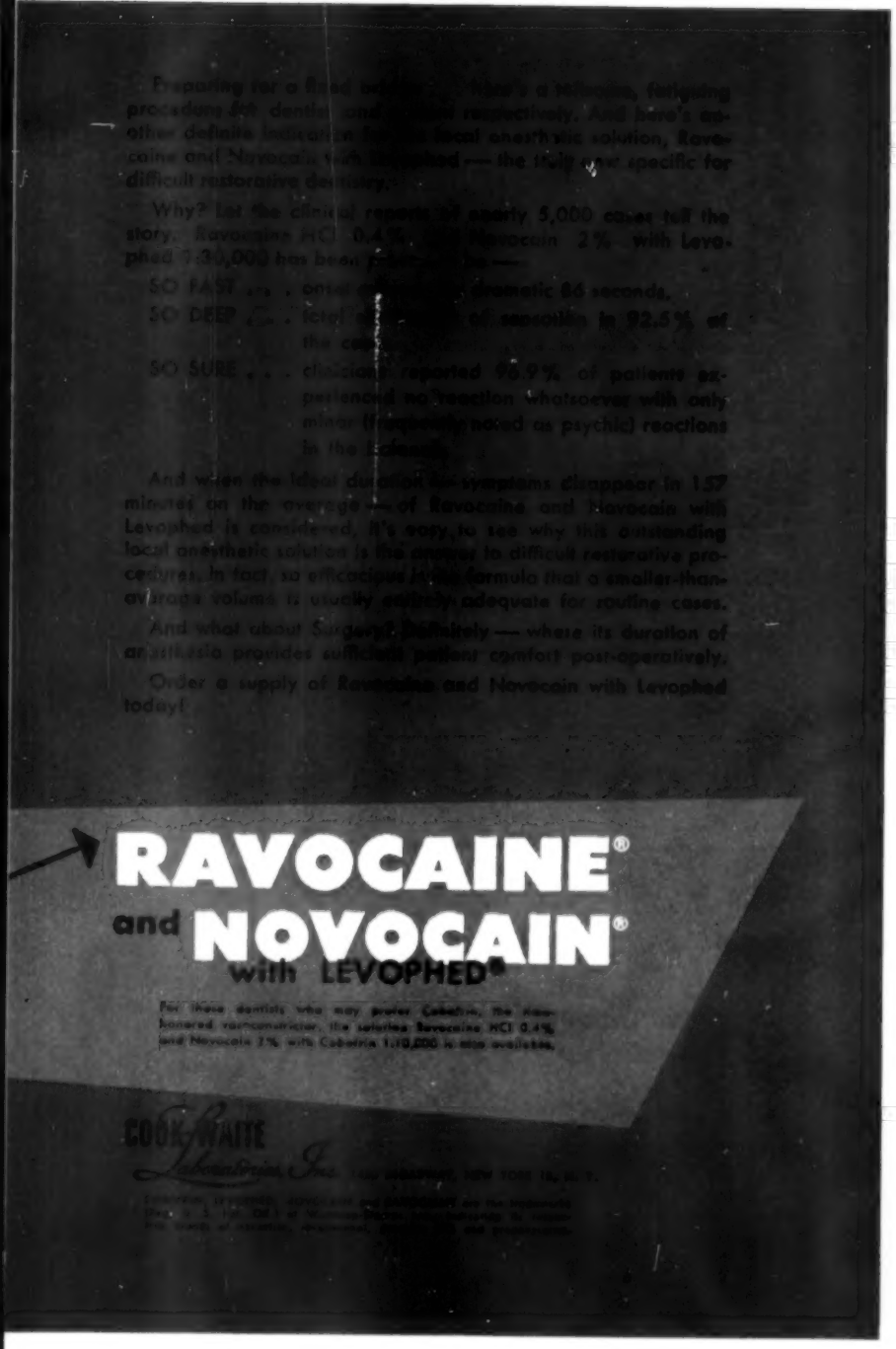
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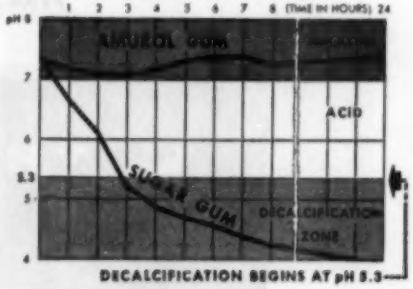

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As shown above, pH of caries-active saliva remains in alkaline zone for hours with AMUROL SUGARLESS GUM, whereas with sugar gum the pH drops to the acid level under the same conditions.

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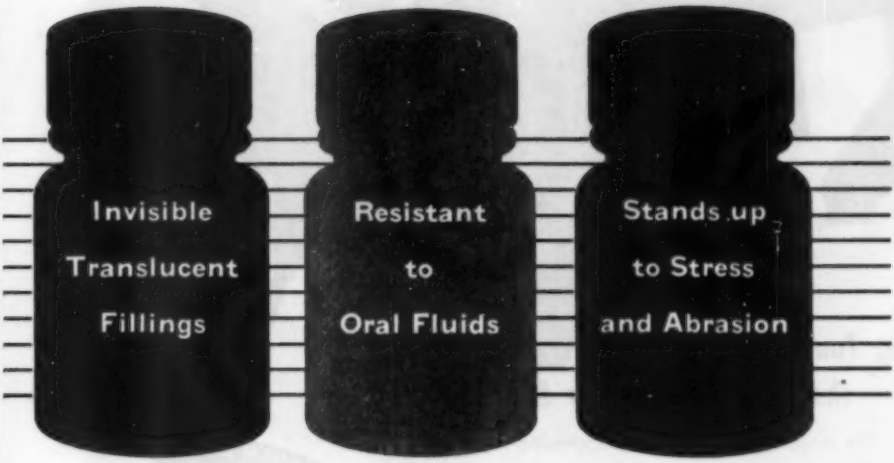

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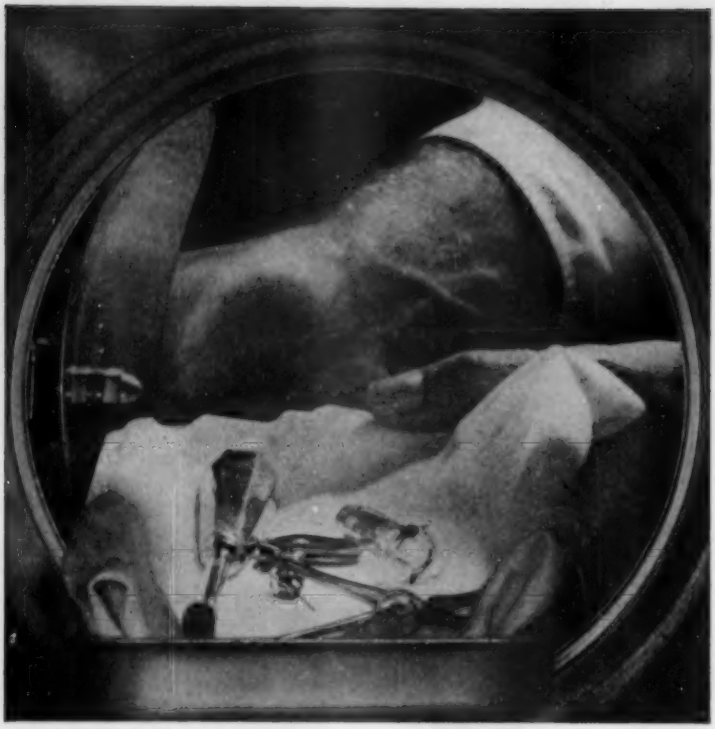

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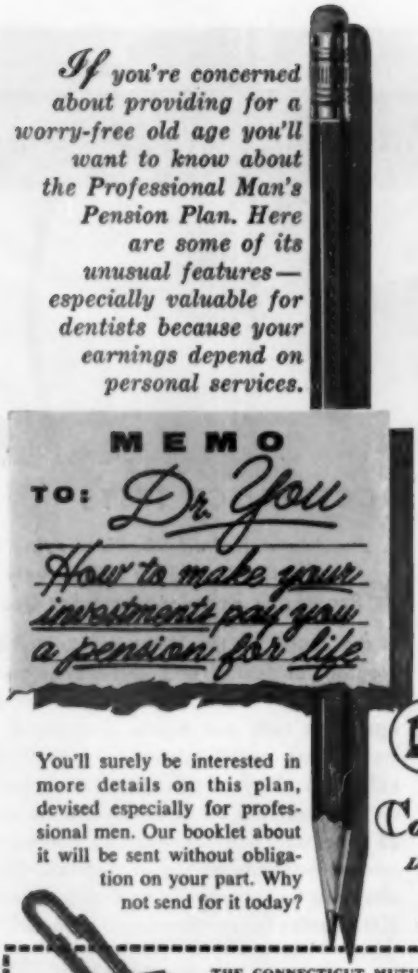

1. When you retire — at whatever age you choose — the plan provides a unique arrangement for converting some of your investments and savings into lifetime annuity income with all its benefits.

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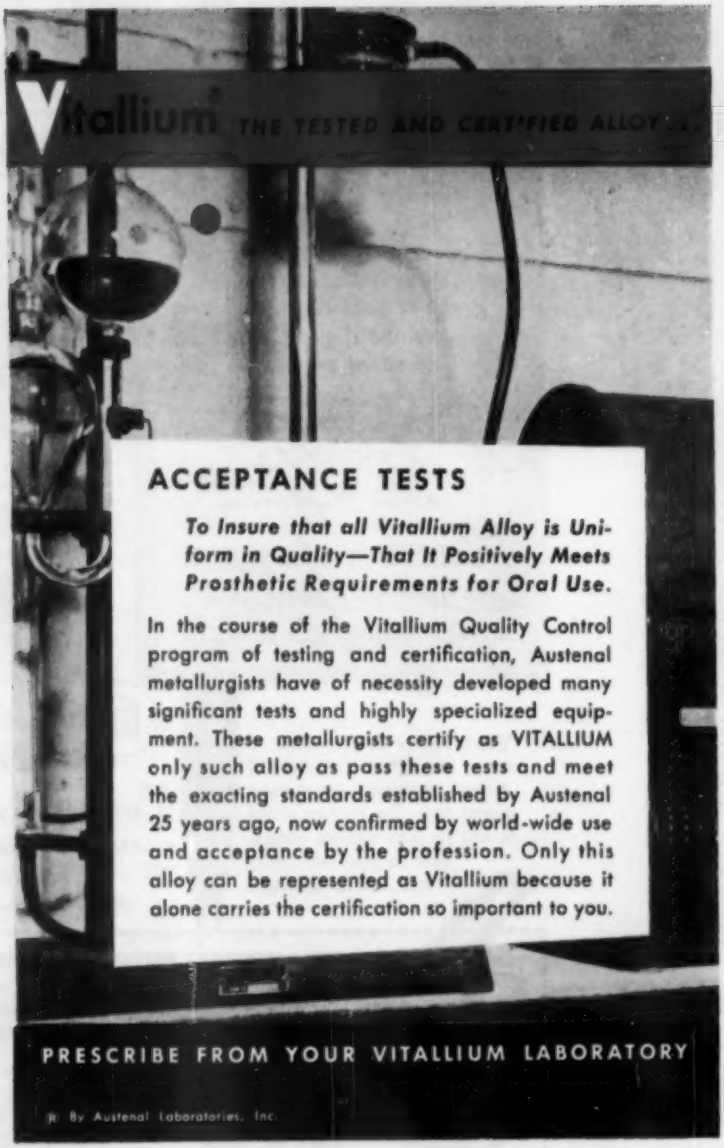
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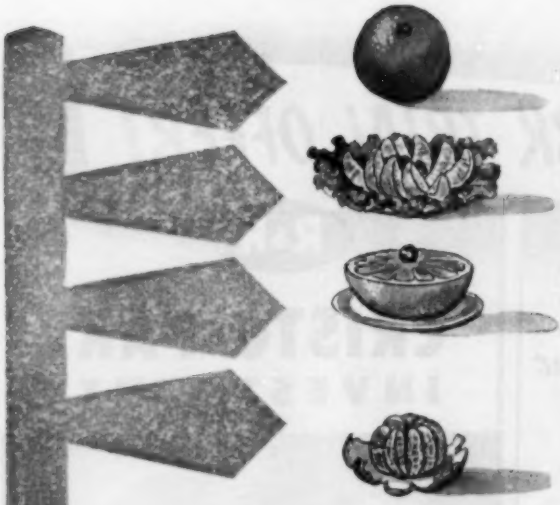

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**Am. Dent. Assoc.: Diet and Dental Health, Chicago, 1954, p. 8.*

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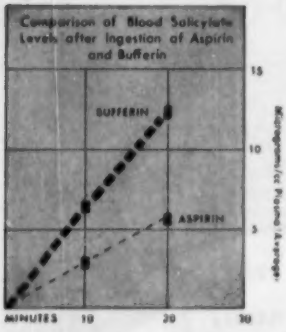

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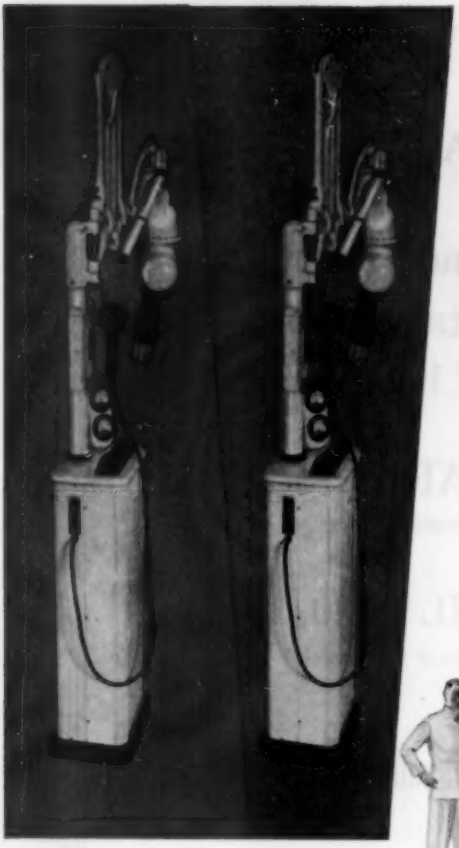

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†*Journal of A.D.A.—February, 1954.*

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Loyola University
1757 West Harrison Street
Chicago 12, Illinois

The Dental School
Northwestern University
311 East Chicago Avenue
Chicago 11, Illinois

College of Dentistry
University of Illinois
808 South Wood Street
Chicago 12, Illinois

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Indianapolis 2, Indiana

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Iowa City, Iowa

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Louisville 2, Kentucky

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New Orleans 15, Louisiana

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Dental School
University of Maryland
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Baltimore 1, Maryland

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Harvard School of Dental Medicine
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Boston 15, Massachusetts

Tufts College Dental School
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Boston 11, Massachusetts

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University of Detroit
630 East Jefferson Avenue
Detroit 26, Michigan

School of Dentistry
University of Michigan
Ann Arbor, Michigan

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Washington Ave. and Union St., S.E.
Minneapolis 14, Minnesota

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School of Dentistry
The University of Kansas City
Kansas City 6, Missouri

School of Dentistry
St. Louis University
2556 Caroline Street
St. Louis 4, Missouri

School of Dentistry
Washington University
4559 Scott Avenue
St. Louis 10, Missouri

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The Creighton University
26th and California Streets
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College of Dentistry
University of Nebraska
Lincoln 3, Nebraska

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College of Dentistry
New York University
209 East 23rd Street
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School of Dentistry
University of Buffalo
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Chapel Hill, North Carolina

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School of Dentistry
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Nashville 8, Tennessee

College of Dentistry
University of Tennessee
Memphis 3, Tennessee

TEXAS

College of Dentistry
Baylor University
Dallas 10, Texas

School of Dentistry
University of Texas
Houston 4, Texas

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School of Dentistry
Medical College of Virginia
Richmond 19, Virginia

WASHINGTON

School of Dentistry
University of Washington
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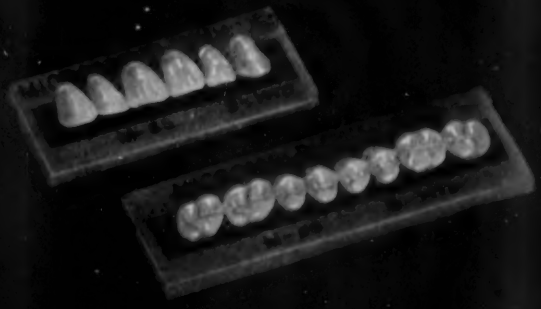

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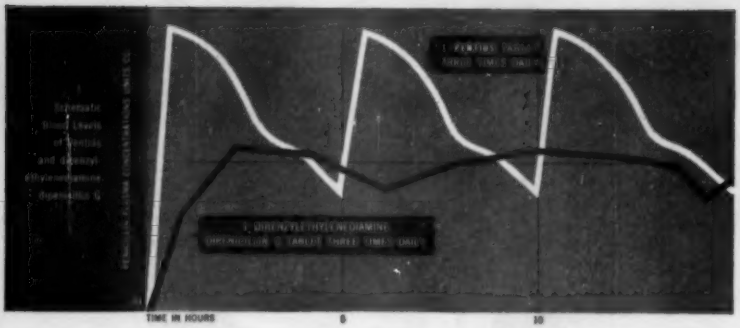

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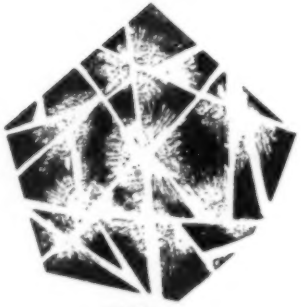

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